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Meteorological & Geoastrophysical ABSTRACTS

Vol. 11 DECEMBER 1960 No. 12
PART I

METEOROLOGICAL AND GEOASTROPHYSICAL ABSTRACTS

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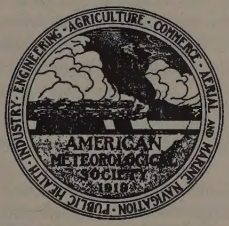
METEOROLOGICAL AND GEOASTROPHYSICAL ABSTRACTS

MALCOLM RIGBY, Editor

Vol. 11 December 1960 No. 12
PART I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(For table of contents see back cover)

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INTRODUCTION

During 1950–1959 (Vol. I–X), *Meteorological Abstracts and Bibliography* consisted of 11 monthly issues (Jan.–Nov.), each with Current Abstracts, a Special Bibliography, Contents of Current Journals, and Author, Subject and Geographic Indexes. The December issue (No. 12) of each year comprised the cumulative annual indexes.

In this volume (Vol. XI) a substantial number of abstracts of literature on the Upper Atmosphere, Space Exploration, Astrophysics of the Solar System, etc., have been included. So many pertinent abstracts in these fields have accumulated during the year, in excess of what could be published in the normal 11 issues, that it was decided that the backlog should be published as a regular December issue under the new title: *Meteorological and Geoastrophysical Abstracts*. In fact, in order to publish the 1000 items accumulated, it was necessary to publish the issue in two parts, the first with 600 abstracts (11.12–1 to 600) and the second with 400 (11L–1 to 400), each with the usual author, subject and geographical indexes. A detailed outline of the contents will be found on the back cover.

The usual cumulative annual indexes will appear subsequently as volume indexes, but without identification by month or number as heretofore.

The work of compiling, editing, arranging, cross-referencing, and indexing of these two parts to the December 1960 issue has been performed by *Geza Thuronyi* with assistance from other members of the editorial staff of Meteorological and Geoastrophysical Abstracts. It is hoped that this material will be more valuable collected and arranged in one issue than it would be scattered through numerous future issues.

The preparation and publication of this issue has been made possible through support extended by the National Aeronautics and Space Administration (NASA).

Malcolm Rigby, Editor

FOREWORD

Meteorological and Geoastrophysical Abstracts is a monthly publication devoted to current literature in meteorology, geophysics and astrophysics.

Part I contains abstracts of current literature in the fields of meteorology, etc.

Part II of each issue comprises an annotated bibliography of important references on a special subject. Bibliographies published in the successive issues were:

Vol. I, 1950

. Atmos. Pollution 2. Aerobiology 3. Cloud Physics 4. Hail
. Tornadoes 6. Volcanic Dust 7. Climat. Changes 8. Thunderstorms
. Icing 10. Acoust. Propagation 11. Evaporation

Vol. II, 1951

. Extended Forecast. 2. Long Range Forecast. 3. Soil Temp. 4. Constants, etc.
. Clim. of Near East 6. Clim. of Middle East 7. Special Winds 8. Radar Storm
. Condensation Trails 10. Clim. of N. E. Africa 11. Mountain Met. Detect.

Vol. III, 1952

. Clim. of N. W. Africa 2. Carbon Dioxide 3. Clim. of Argentina, etc. 4. Dew
. Objective Forecast. 6. Stratus Forecast. 7. Urban Climatology 8. Clim. of C. Africa
. Visibility 10. Glaze and Rime 11. Free Air Turbulence

Vol. IV, 1953

. Turbulence Theory 2. Turbulent Diffusion 3. Frost 4. Clim. of Australia, etc.
. High Level Winds 6. Winds in Stratosphere 7. Jet Stream 8. Radiation Bioclim.
. Clim. of Pacific 10. Auroras 11. Sferics

Vol. V. 1954

. Oceanog. Met. 2. Clim. of S. E. Asia 3. Auroral Physics 4. Tropopause
. Balloons 6. Numerical Forecast. 7. Radiation Data 8. Vertical Motion
. Clim. of Arctic 10. Industrial Met. 11. Wind Waves and Swell

Vol. VI, 1955

. Bibliog. of Bibliog. 2. Texts & Monogr. Bibliogs. 3. Storm Surges
. Ionospheric Prop. 5. Photochem.—Upper Atmos. 6. Cloud Physics
. Radar Cloud Physics 8–9. Atmos. Nuclei 10. Weather Modification 11. Cooling Power

Vol. VII, 1956

. Synoptic Met.-Arctic 2. Clim. of Enclosed Spaces 3. Cosmic Rays (–1952)
. Cosmic Rays (1953–56) 5. Atmos. Radioactivity 6. Inversions
. Snow Micromet. 8. Snow Micromet. (Suppl.) 9–11. Tropical Cyclones

Vol. VIII, 1957

. Solar Weather Relations 2. Night Airglow 3. Forecasting Special Elements
. Forest Micrometeorology 5. Hydromet. Forecasting 6. Numerical Forecast. (Suppl.)
. Albedo 8. Meteors 9–10. Tropospheric Prop. 11. Medical Meteorology

Vol. IX, 1958

. Radioastronomy 2. Solar Astrophysics 3. Radioactivity in Atmosphere
. Waves and Currents 5. Physical Oceanog. 6. Dynamic & Phys. Oceanog.
. Long Range Forecast. 8. Radar Met. 9. Cosmic Rays 10–11. Geomagnetism

Vol. X, 1959

1. Works of C. E. P. Brooks 2. Tornado Forecasting 3. Soil Moisture 4. Sferics
5–6. Ozone 7. Acoustic Waves 8. Evaporation Measurement
9. Evapotranspiration (–1955) 10. Evapotranspiration (1956–1959) 11. Evaporation

Vol. XI, 1960

1. Outstanding Reference Works 2. Outstanding Texts 3. Numerical Forecast. (Suppl.)
4. Ionospheric Physics 5. Ionospheric Propagation 6. Ionosphere
7. Forecast Verification 8. Radar Meteorology 9. Rocket Meteorology
10. Satellite Meteorology 11. Airglow

Bibliographies in preparation or published in Vol. XII

Aurora (No. 1) *Limnology* (No. 3) *Physics of Lightning*
Auroral Physics (No. 2) *Upper Atmosphere Structure* (No. 4, 5 and 6) *Precipitation Chemistry*

Part III contains a listing of reviews, translations, reprints, and the contents of important publications. These are published in the earliest issue where space permits.

Part IV is made up of author, subject and geographical indexes.

EXPLANATIONS

Location of material: For each entry, a symbol is given for at least one library where the material may be found. The Union List of Serials (Gregory) is the source of most of the symbols used. In some cases, where no symbol has been assigned to a library, one will be devised according to the principles of the Union List.

Library symbols used frequently may be found in the following list:

DA:	U. S. Dept. of Agriculture Library, Washington, D. C.
DBS:	U. S. Bureau of Standards Library, Washington, D. C.
DGS:	U. S. Geological Survey Library, Washington, D. C.
DLC:	Library of Congress, Washington, D. C.
DN-HO:	U. S. Navy Hydrographic Office Library, Suitland, Md.
DNLM:	U. S. National Library of Medicine, Washington, D. C.
DSI:	Smithsonian Institution, Washington, D. C.
DWB:	U. S. Weather Bureau Library, Washington, D. C.

Other symbols:

*	before an entry indicates a good data source.
†	before an entry indicates a good bibliography.
§	before an entry indicates a synoptic case history study accompanied by charts.
Ⓢ	after an abstract indicates an abstract prepared for NASA.

Geographic locations are in the English form rather than the form used locally, for example, Moscow for Moskva.

Titles of articles or monographs are in the language of the original article unless otherwise stated. Slavic (Cyrillic) titles are transliterated into the Roman alphabet using a modification of the Library of Congress transliteration scheme.

Abbreviations:

Titles of periodicals are not abbreviated, as a rule.

The months of the year from March to July are not abbreviated. Other months are abbreviated as Jan., Feb., Aug., Sept., Oct., Nov., and Dec.

The word or abbreviation for Volume (Tom, Band, Jahrgang, Año, etc.), for Number (Heft, Fascicule, Vypusk, etc.) and for page or pages is omitted from most entries. Thus an entry will read as follows:

Meteorologische Rundschau, 2(5/6):146–151, May/June 1950.

This indicates that the article appeared in *Meteorologische Rundschau*, *Jahrgang* 2 (Vol. 2), *Heft* 5/6 (No. 5/6), *pages* 146–151, May/June 1950.

ABSTRACTS OF CURRENT GEOASTROPHYSICAL MATERIAL

A. ASTRONOMY AND ASTROPHYSICS

1. GENERAL

See also: **Radio studies of the universe** (Davies, Palmer), 11.12–36

11.12–1 551.507.362:551.521.64

Hones, Edward W., Jr., **Antiparticles in space.** *Physical Review Letters*, N. Y., 2(12):509–510, June 15, **1959.** fig., 8 refs., 2 eqs. **DWB, DLC**—A theoretical note on creation of matter in space by way of segregation of matter and antimatter. The ratio of the latter may be more stringently limited than assumed. Detection of antiparticles and their number density is suggested as observable by simple experimental equipment satellite or rocket borne. Detection of positron may not mean proof of the existence of antimatter since the former may stem from cosmic ray showers or other solar activities. Characteristic annihilation gamma rays rather would serve to test existence of antimatter. *Subject Headings:* **1. Outer atmosphere investigations 2. Cosmic ray showers at high altitudes 3. Antimatter.**—*W.N.* Ⓢ

11.12–2 523.112 530.12

Hoffmeister, C., **Unendlichkeit.** [Infinity.] *Die Sterne*, Leipzig, 36(5/6):112–116, May/June **1960. DLC**—The articles in *Die Sterne* being for the greatest part too scientific for many readers, the author presents this subject in a form similar to that of the articles regularly published in *Sky and Telescope.* He explains the theories of space by EUCLID and sets out the evolution of theory according to the ideas of ARCHIMEDES, NEWTON, MORLEY, MICHELSON, GAUSS and EINSTEIN. *Subject Headings:* **1. Cosmology 2. Cosmogony 3. Expanding universe 4. Relativity theories.**—*A.V.* Ⓢ

11.12–3 529.78:681.11 551.521.11

Egger, Hermann, **Die Universalsonnenuhr.** [The universal sundial.] *Die Sterne*, Leipzig, 35(11/12):242–243, Nov./Dec. **1959. DLC**—Short description of a recent universal sundial giving the possible sunshine at every moment and the solar time at any place in the world. *Subject Headings:* **1. Solar clock 2. Sunshine.**—*A.V.* Ⓢ

11.12–4 551.852.33:523.821

Hodge, Paul W. (*Harvard College Obs.*), **The extragalactic distance scale.** *Nature*, London, 186(4725):622, May 21, **1960.** 5 refs. **DWB**—Examinations of color magnitude diagrams obtained by ARP for four clusters in the small magellanic cloud and of those obtained by the author for six clusters in the large magellanic cloud, indicate that the distances of the nearest galaxies determined from the apparent magnitudes of the giant evolved stars are not necessarily correct. *Subject Heading:* **1. Astronomical distances.**—*O.T.* Ⓢ

11.12–5 535.22

Ruderfer, Martin, **First-order terrestrial ether drift experiment using the Mössbauer radiation.** *Physical Review Letters*, N. Y., 5(5):191–192, Sept. **1960.** fig., 6 refs., 2 eqs. **DLC**—This note proposes a terrestrial experiment which has considerable sensitivity when the Mössbauer radiation is used and which permits a first-order test for a variation in the velocity of light with direction in space. An arrangement for the detection of a one-way variation

in the observed velocity of light is shown. If $v \neq 0$, the observed velocity of light varies with angle θ in contradiction with the second postulate of the special theory, only the contraction theory can be correct, and a Lorentz ether then physically exists. *Subject Headings:* **1. Mössbauer radiation 2. Velocity of light 3. Lorentz ether.**—*E.Z.S.* Ⓢ

11.12–6 52:061.3

Ahnert, P., **Die 44. Tagung der Astronomischen Gesellschaft vom 22. bis 26. September 1959 in Kiel.** [The 44th session of the Astronomical Society, Sept. 22–26, 1959 at Kiel.] *Die Sterne*, Leipzig, 36(5/6):104–112, May/June **1960. DLC**—Meeting at Kiel of 150 astronomers at the Institute for Chemistry, Kiel University, with Prof. TEN BRUGGENCATE as chairman, who gave a lecture on the history of astronomy at this University. The scientific program dealt with all the different fields of modern astronomy. Plans for organization of an international observatory in South Africa were presented by O. HECKMAN. Details about the 7.5 m radio telescope were given by A. UNSOLD; J. RICHTER developed a photometer for measuring stellar spectra and G. BRUCKNER described a recording photometer. Three communications on the research on interplanetary material were presented. The author gives a good detailed summary of the proceedings and presents the various conclusions. *Subject Heading:* **1. Astronomical conferences.**—*A.V.* Ⓢ

11.12–7 52(06) 551.521.64:016 551.507.362:016

†**Astronomischer Jahresbericht,** [Astronomical annual report], Vol. 57, 1957, issued Berlin, Walter de Gruyter, **1959.** 525 p. Subtitle: **Die Literatur des Jahres 1957.** [Literature of the year 1957.] Ed. by K. Heinemann, E. Henn and W. Lohmann (*all, Astronomisches Rechen-Institut, Heidelberg*). **DLC** (QB1.A797)—The present bibliography, partly annotated, contains a section on cosmic rays and in the last section on astronautics and rockets there is a subsection on artificial earth-satellites. An English subject index and an author index have been provided. *Subject Headings:* **1. Cosmic ray bibliographies 2. Astronomy bibliographies 3. Astronautics bibliographies.**—*O.T.* Ⓢ

11.12–8 523.036

Böhm, K. H. and Richter, E. (*both, Inst. für Theoretische Physik, Univ. Kiel*), **Konvektion in einer Atmosphäre mit tiefenabhängigem Temperaturgradienten und starker Dichtevariation.** [Convection in an atmosphere with a depth-dependent temperature gradient and strong density variations.] *Zeitschrift für Astrophysik*, Berlin, 50(2):79–95, **1960.** 8 figs., 3 tables, 11 refs., 30 eqs. English summary p. 79. **DLC**—The thermal convection in three-layer model atmospheres of the following kind is investigated: A convective zone consists of a narrow layer with a large excess of the actual temperature gradient over the adiabatic one, superposed on a deep layer with a much smaller excess temperature gradient. On the top of the whole convection zone there is a stable zone of small thickness. A large density variation between the top and the bottom of the convection zone is taken into account. The relation between the horizontal wave number of a disturbance and the degree of instability has been derived for four different models of this type and leads to the following conclusions: 1) the rapid increase of the degree of instability with increasing wave number as found by SKUMANICH (1955) depends critically on the assumption that the unstable zone extends exactly up to the surface of the star. Even if the convection zone is superposed only by a narrow stable layer the increase of instability with wave number is much slower. 2) Modes of convection with vertical mass flow confined essentially to the narrow layer of high excess temperature gradient increase much more rapidly with time than modes with a large exchange of matter between both parts of the convection zone. 3) For a model with constant polytropic exponent within the unstable zone, convective modes of large horizontal wave number also show a larger flow of mass in the upper regions of the zone than in the lower part, but the effect is much less pronounced than in the case of a two-layer model of the unstable zone. The assumption of the characteristic scale of the mass flow being proportional to the scale height (for pressure, the density or the temperature) leads to inconsistencies. *Subject Headings:* **1. Thermal convection 2. Temperature gradient 3. Density gradients 4. Large scale exchange 5. Stellar atmospheres.**—*Authors' abstract.* Ⓢ

11.12–9 523.16

†Scheffler, Helmut, **Methodik und Ergebnisse bei der Ermittlung der Verteilung des interstellaren Staubes.** [Methods and results of the determination of interstellar dust distribution.] *Berlin. Universität, Wissenschaftliche Zeitschrift: Mathematisch-Naturwissenschaftliche Reihe*, 8(4/5):641–649, **1958/1959.** 2 tables, 47 refs., 10 eqs. German, Russian, English and French summaries p. 649. **DLC** (AS182.B69)—The methods of determining the distribution in space of interstellar dust can be divided in two groups: methods aiming at the derivation of the individual structures of the distribution of dust, and methods based on the statistical treatment of the medium of dust as a whole and serving the establishment of statistical data concerning this distribution. Here the main stress is put on the latter aspect of the problem which is still in development, and methods and results connected with it are critically described and discussed. The discussion of the studies made so far on the angular correlation of the surface brightness of the Milky Way confirms the necessity of a new statistical model of the distribution of dust in space. Further it is maintained that the apparently contradicting findings about the distribution of cloud absorptions are yet compatible with each other. *Subject Heading:* **1. Interstellar dust.**—*Author's abstract.* Ⓢ

11.12–10 523.823 523.875

Starikova, G. A., **Funktsii svetimosti i tsveta zvezd.** [Luminosity and color functions of stars.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):476–491, May/June **1960.** 3 figs., 11 tables, 21 refs., 10 eqs. Russian and English summaries p. 476. Transl. into English in *Soviet Astronomy AJ, New York*, 4(3):451–464, **1960. DLC**—The luminosity function was found for stars to 6^m0 and for stars in a sphere with a radius of 20 *ps*. Data on luminosity classes and the influence of light absorption were taken into account. The luminosity and color functions for different sequences of the color-luminosity diagram, $lg\varphi_L(M)$ and $lg\psi_L(C)$, were studied, and also the luminosity function and colors of all the investigated stars. The functions are reduced to the galactic plane. The functions of stars with given characteristics are given as the number of stars with the corresponding characteristics in 1000 ps^3. The absolute magnitudes are visual and the colors are in the (B-V) system. The percentage of stars with different characteristics is calculated. The relative numbers of stars along the main sequence are considered. It is concluded that there is a considerable admixture of stars of the spherical component among stars of other sequences with similar M and C characteristics. *Subject Headings:* **1. Brightness of stars 2. Color of stars.**—*Author's abstract.* Ⓢ

11.12–11 523.841.11:523.874

Krasnozhenov, E. P. and Porfir'ev, V. V., **O konture linii pogloshcheniia v spektre Novykh.** [Absorption line profiles in the spectra of novae.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):589–590, May/June **1960.** fig., ref. Russian and English summaries p. 589. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3):560–561, **1960. DLC**—The profile of an absorption line formed in an expanding envelope with a velocity gradient is determined. It is assumed that the line profile is Doppler. *Subject Headings:* **1. Stellar spectra 2. Novae.**—*Authors' abstract.* Ⓢ

11.12–12 523.841.3:521.115

Artiukhina, N. M. (*P. K. Shternberg State Astronomical Institute, U.S.S.R.*), **Photographic proper motions and the mean parallax of RW aurigae variables.** *Soviet Astronomy AJ*, New York, 4(1):91–96, July/Aug. **1960.** 6 tables, 6 refs. **DLC.** Transl. of **Fotograficheskie sobstvennye dvizheniia i srednii parallaks peremennykh zvezd tipa RW Voznichego.** *Astronomicheskiĭ Zhurnal*, Moscow, 37(1):95–100, Jan./Feb. **1960. DLC**—The photographic proper motion of 20 RW Aur-type variables were found using astrographic catalogs and photographs taken with the 38-cm ($f=640$ cm), and the wide-angle ($f=230$ cm, d 2 230 mm) astrographs of the Shternberg Astronomical Institute. The proper motions were reduced to absolute by a statistical method. The mean parallax $\pi_r=0''.0026$ was found from the parallactic components of the proper motions of 19 RW Aur-type stars. Thus, the mean distance of RW Aur-type stars, estimated using their meridian and photographic proper motions, is in good agreement with the distance to these stars found from the spectrum-luminosity diagrams for T-associations, these stars being members of the latter. The mean parallax of 10 stars belonging to the

group of T-associations in Taurus-Auriga is 0″.0047, which is in good agreement with the photometric distance to this group of associations, i.e., 170–200 pc. This conclusion contradicts the results stated in an earlier paper, due to errors in the values of the proper motions, published in that paper. *Subject Headings:* **1. Astrophotography 2. Stellar motions.**—*Author's abstract.* Ⓢ

2. OBSERVATORIES, METHODS, INSTRUMENTS

See also: **Spectroelectrophotometer with automatic recording** (Boĭko), 11.12–29; **Radio astronomy instruments** (Section A2), 11.12–40 to 11.12–44; **Balloon telescope for exploring solar photosphere** (Umschau), 11.12–84; **Photogrammetric method for determining points on a meteor trajectory** (Rozenblium), 11.12–140; **Cosmic ray instruments** (Section B2b), 11.12–201 to 11.12–204; **Rocket and satellite measurements of cosmic rays** (Section B2c), 11.12–205/206; **Space rockets** (Section C6), 11.12–509 to 11.12–530; **Observation and tracking of satellites** (Section C7c), 11.12–556 to 11.12–569; **Scientific measurements with satellites** (Section C7d), 11.12–570 to 11.12–591.

11.12–13 522.1(47)(09)

Chenskal, V. L., **Das Astronomische Observatorium der Petersburger Akademie der Wissenschaften im 18. und Anfang 19. Jahrhunderts.** [The astronomical observatory of the Petersburg Academy of Sciences in the 18 and the beginning of the 19 century.] *Die Sterne*, Leipzig, 36(3/4):72–81, March/April **1960.** 7 figs. **DLC**—The observatory of the Academy of Sciences was the first one in Russia. The author has consulted the Russian archives to give a good insight of the history of this observatory built after the plans of MATTARNOVIS, later changed by the French astronomer JOSEPH DELISLE in 1726. First observations were made by the French scientist and the first instruments came from the Marine Academy founded in St. Petersburg in 1715. In 1731 CHRISTIAN NICOLAUS WINSHEIM made his first observations and from 1736 GOTTFRIED HEINSINS began his research work. The development of science made it necessary for the Russian government to build the Pulkovo Observatory (1835–1839) and the observatory of the Academy of Sciences was closed in 1884. *Subject Headings:* **1. Astronomical observatories 2. History of astronomy.**—*A.V.* Ⓢ

11.12–14 522.982.2

Pil'nik, G. P., **Kollimatsionnye oshibki v astronomicheskikh nabliudeniiakh.** [Collimation errors in astronomical observations.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):567–578, May/June **1960.** fig., 6 tables, 3 refs., 8 eqs. Russian and English summaries p. 567. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3):539–548, **1960. DLC**—Considerable errors were found in the position of the sight-line of two transit instruments from observations of collimators at the zenith and horizon. The comparison of observations of the collimators and stars leads to the conclusion that the most serious errors in astrometrical observations are the collimation errors. Some possible causes for the variations of collimation are considered. *Subject Headings:* **1. Collimation errors 2. Astronomical observation errors.**—*Author's abstract.* Ⓢ

11.12–15 526.6

Johns, Roman K. C. (*Lab. for Electronics, Inc., Boston*), **Some remarks on geodetic astronomy.** *American Geophysical Union, Geophysical Monograph*, No. 4:23–29, **1959.** 3 figs., 5 eqs. **DWB, DLC** (QB275.C64 1958)—The primary objective of geodetic astronomy is the precise determination of longitude, latitude, and azimuth from observations of celestial bodies. Applications are indicated, such as astronomical control of geodetic triangulation and trilateration nets, determination of boundary information about the figure of the earth, detection of crustal movements of the earth, from azimuth observations, establishment of poles' movements. Basic terminology used in geodetic astronomy is explained. Discussion of method utilized for observation of the parallactic angle; BERNOULLI'S techniques and plumb deflection. Astronomic equipment, and computations require attention to be made more effective. The author looks for closer relationship between geodetic astronomers and space scientists. Dr. JOHN A. O'KEEFE led the panel discussion with a challenging paradox connected with azimuths. He contended that north is obsolete and should not be a part of modern geodesy. *Subject Headings:* **1. Geodetic astronomy 2. Geodetic triangulation.**—*E.Z.S.* Ⓢ

11.12–16 526.61/3 529.7

Butkevich, A. V. (*Novosibirsk Inst. of Geodetic Aerophotosurvey, and Cartographic Engineers*), **Application of geodetic principles to practical astronomy.** *Soviet Astronomy AJ*, New York, 4(1):154–165, July/Aug. **1960.** 3 figs., 6 tables, 12 refs., 64 eqs. **DLC.** Transl. of **O primenenii printsipov geodezii v prakticheskoĭ astronomii.** *Astronomicheskiĭ Zhurnal*, Moscow, 37(1):161–172, Jan./Feb. **1960. DLC**—The possibility of carrying over the principles and techniques of geodesy to practical astronomy is demonstrated as an example of the effectiveness achievable in relating two adjacent disciplines. This possibility is fraught with great practical and methodological significance. Three questions are taken up: 1) application of Legendre's theorem for computing azimuth and latitude from observations of Polaris; 2) use of the principle of the general arithmetic mean for computing and estimating the precision of chronometer corrections; and, 3) computing and evaluating scale values of ocular-micrometer-screw turns from the adjustment of directions and angles. *Subject Headings:* **1. Geodesy 2. Astronomy.**—*Author's abstract.* Ⓢ

11.12–17 522.5:771.3:523.3

Potter, Kh. I. and Streletskiĭ, Iu. S. (*both, Acad. Scien., U.S.S.R.*), **A camera for the observation of the Moon with the normal astrograph at the Main Astronomical Observatory of the Academy of Sciences, U.S.S.R. in Pulkovo.** *Soviet Astronomy AJ*, New York, 3(6):960–964, May/June **1960.** 3 figs., 2 tables, 2 refs., 4 eqs. Transl. of **Kamera dlia nabliudeniĭ Luny na normal'nom astrografe Glavnoĭ Astronomicheskoĭ Observatorii Akademii Nauk SSR v Pulkove.** *Astronomicheskiĭ Zhurnal*, Moscow, 36(6):1047–1052, Nov./Dec. **1959. DLC**—The main principles underlying the design of a camera for Moon observations according to the Markowitz method are given. The camera, built at the Pulkovo workshop for use with the normal astrograph, is described. *Subject Headings:* **1. Moon 2. Photographic equipment 3. Astrophotography.**—*Authors' abstract.* Ⓢ

11.12–18 522.614.4

Esipov, V. P., **O fotografirovanii zvezd elektronno-teleskopicheskim metodom.** [Photography of stars with an image converting telescope.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):588–590, May/June **1960.** 2 figs., 5 refs. Russian and English summaries p. 588. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3):558–560, **1960. DLC**—Photographs of stars were obtained by using an image converting device with a contact tube. The gain obtained reaches 30–40 times. *Subject Headings:* **1. Astrophotography.** 2. Telescopes.—*Author's abstract.* Ⓢ

11.12–19 523.8:535.243

Dimov, N. A., **Zvezdnyĭ integriruiushchiĭ elektrospektrofotometr.** [An integrating stellar spectrophotometer.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):464–468, May/June **1960.** 4 figs., 3 tables, 8 refs. Russian and English summaries p. 464. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3):440–444, **1960. DLC**—A new type of stellar spectrophotometer with integration is described. An interval of the observed spectrum is scanned by moving of the spectrophotometer exit slit. During the motion of the slit from one to the other end spectral interval, the integrating capacitors are connecting one after another with the multiplier by a special electromechanical device. The potentials of the capacitors are averaged by repeated scanning. One scanning time is 25 sec, the number of scans up to 15. In such a way, an increase in observational time is reached without any loss of accuracy due to drift and atmospheric transparency variations. The hydrogen absorption line records obtained at different times with a 50 cm reflector, show the reliability up to 1% for the stars 3^m–4^m and 1.5–2% for the stars 5^m, when the dispersion is 25 A/mm and observation time is 4–8 min. *Subject Headings:* **1. Stellar spectroscopy 2. Spectrophotometers.**—*Author's abstract.* Ⓢ

11.12–20 523.852:522.61

Shcheglov, P. V., **Opyt fotografirovaniia tumannosteĭ na elektronnom teleskope.** [Photography of nebulae with an image converting telescope.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):586–588, May/June **1960.** 3 figs., 3 refs. Russian and English summaries p. 586. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3), **1960. DLC**—A photograph

of nebulae in $H\alpha$ by means of a contact image converting telescope is described. *Subject Headings:* **1. Nebulae 2. Telescopes 3. Astrophotography.**—*Author's abstract.* Ⓢ

11.12–21 523.4:778.3

Kirby, Donna Scott (*The Rand Corp., Santa Monica, Calif.*), **Multiple image printing for planetary photography.** *Astronomical Society of the Pacific, San Francisco, Publications,* 71(421):334–337, Aug. **1959.** 2 plates, 4 refs. **DLC**—A discussion of the problem of recording fine detail in planetary photography. Photographs do not catch the fine markings on planetary surfaces because the image blurs due to atmospheric seeing. Difficulties are also encountered because of the limitations in the photographic process itself. In this paper some features of the multiple image printing method for making planetary photographs are discussed as one way of minimizing these losses. *Subject Heading:* **1. Astrophotography.**—*I.S.* Ⓢ

11.12–22 523.4:778.3

Seitter, Waltraut, **Astronomische Farbphotographien.** [Astronomical color photographs.] *Die Sterne,* Leipzig, 36(3/4):84–85, March/April **1960.** 4 refs. **DLC**—Comment on color photographs of planets by C. Miller, photographer at the Mount Wilson and Mount Palomar observatories. The process is described and the results are shown on six examples. An astronomer declared: "In two minutes of examining the color photographs I have learned more than in 2 years of study with photographs in black and white." *Subject Headings:* **1. Color photography of planets 2. Astrophotography.**—*A.V.* Ⓢ

11.12–23 523.036.51

Bruce, E. R., Charles, **Un thermomètre cosmique à vitesse de gaz.** [A gas speed cosmic thermometer.] *Académie des Sciences, Paris, Comptes Rendus,* 250(1):61–63, Jan. 4, **1960.** 8 refs. **DWB, DLC**—The author's "electric discharge" theory which applies to several cosmic phenomena, establishes a ratio between the gas temperature and its speed. For discharges in stellar and galactic atmospheres the agreement between theory and observation has been checked for temperatures between 5000°K and approximately 400,000,000°K. *Subject Headings:* **1. Cosmic thermometers 2. Gas temperature-gas velocity relationships.**—*A.V.* Ⓢ

11.12–24 535.035.72:523.77

Becherer, Rudolf, **Un spectrographe simple de la résonance paramagnétique solaire.** [A simple spectrograph for solar paramagnetic resonance.] *Académie des Sciences, Paris, Comptes Rendus,* 250(6):1037–1039, Feb. 8, **1960.** 4 figs. **DWB, DLC**—Description of a new spectrograph which constitutes an improvement of the F. Bloch spectrograph. A scheme of the principle and a diagram of the apparatus show the arrangement of the main parts of the instrument. The new design uses directly a synchronous detector working with the high frequency signal (30 MHz). The frequency of oscillation is produced by a quartz oscillator; as usual, it attacks at first the emitting coil; it feeds also the reference tension of the synchronous detector through the instrumentality of the phasetransformer. The setting of the phasetransformer permits the selection of a dispersion or an absorption signal at will. The author explains the advantages of this new spectrograph. *Subject Heading:* **1. Spectrographs.** —*A.V.* Ⓢ

11.12–25 535.247

Guérin, Pierre (*Institut d'Astrophysique, Paris*), **Réalisation et possibilités d'emploi d'un spectrophotomètre stellaire photoélectrique à compensation.** [Construction of a compensated photoelectric stellar spectrometer, and possibilities of its use.] *Annales d'Astrophysique,* Paris, 22(6):611–680, Nov./Dec. **1959.** 25 figs., 30 refs. French, English and Russian summaries. **DWB, DLC**—Description of an experimental stellar photoelectric low dispersion spectrophotometer (mean resolving limit: 44 Å) using two Lallemand 19-stage photomultipliers, one for the scanning of spectra, the other for the compensation of the admitted flux. Spectral interval is 6.000–3500 Å. Tracings are made on sensitive paper by the Poggendorf method, using a logometer. Study of the working conditions on the sky. The instrument has been used for the determination of the relative gradients and Balmer discontinuities for early type stars of magnitude less than 8. Plans for the construction of a new spectrophotometer of the

same type, to be used in the accurate determination of the equivalent widths of isolated lines. *Subject Heading:* **1. Photoelectric spectrophotometers.**—*Author's abstract.* Ⓢ

11.12–26 551.508.93:535.33

Hadni, Armand; Décamps, Edmond; Grandjean, Denise and Janot, Christian, **Etude expérimentale de la polarisation de la lumière par les réseaux échelette entre 1 et 600μ.** [Experimental study of light polarization by diffraction gratings between 1 and 600μ.] *Académie des Sciences, Paris, Comptes Rendus*, 250(11):2007–2009, March 14, **1960.** 6 figs., 3 refs. **DWB, DLC**—Summary of the study of a dozen gratings in polarized light, in view of their rational use in spectrometers. The authors examine successively the spectra ranging about zero of long wavelength radiations ($\lambda > 100\mu$) and spectra ranging about I of the far infrared and near infrared. The effects of polarization appear to be very important and complex. *Subject Headings:* **1. Polarimetry 2. Polarization effects 3. Polarization measurement equipment.**—*A.V.* Ⓢ

11.12–27 523.28(09)

Chamberlain, Joseph M., **The sky in replica: model solar systems, once clockwork, are optical projections today.** *Natural History*, N. Y., 69(2):9–14, Feb. **1960.** photos. **DWB, DLC**—A paper presenting a historical survey of the development of model solar systems. From the earliest machines, designed to show the relative motions of the sun, the moon and the planets, the steady progress in time to the modern planetariums is described. The first mechanical model in modern times was that built by CHRISTIAN HUYGENS (1629–95) after which the orrery models were constructed. Another type of planetarium, finished in the 1600's, is known as the Gottorp Globe. Today the "planetarium" connotes much more than a model of the solar system. It also embraces exhibits concerning astronomical, navigational, and related subjects as well as accomplishments related to outer space. The paper is nicely illustrated by photographs of historical solar models and modern planetariums. *Subject Headings:* **1. Solar system models 2. Planetariums.**—*I.S.* Ⓢ

3. ATMOSPHERIC PHENOMENA AFFECTING OBSERVATION

11.12–28 525.723:551.593.7(62)

Piaskovskaia-Fesenkova, E. V., **Nekotorye dannye o poliarizatsii neba v Iuzhnom Egipte.** [Data on sky polarization in southern Egypt.] *Akademiia Nauk Kazakhskoĭ SSR. Astrofizicheskiĭ Institut, Izvestiia*, 8:82–97, **1959.** 9 figs., 10 tables, 4 refs., 8 eqs. English summary p. 97. **DLC**—During Oct.–Nov. 1957 author made measurements of brightness and polarization of the sky at daytime in the South Lybian desert near Aswan, Egypt, according to methods worked out previously. Polarization in zenith was revealed to be very considerable, that is up to 81%, especially in the afternoon. Polarization at the angular distance 90° from the sun and at the same almucantar has been revealed to be very stable, especially in the afternoon. Its orientation nearly coincides with that calculated theoretically for scattering of the first order. The scattering coefficient determined from the observations made along the sun's almucantar was divided by natural and polarized ions. Further, this scattering coefficient was also divided into two components due to gas and aerosol scattering. The latter was analysed in such a manner as to deduce a purely polarized part. Maximum of polarization directly observed corresponds to the angle of scattering 90–100° and for the aerosol component to the angle 120°. *Subject Headings:* **1. Sky light polarization 2. Brightness measurements 3. Aswan, Egypt.**—*Author's abstract.* Ⓢ

11.12–29 535.243:525.723

Boĭko, P. N., **Spektroelektrofotometr s avtomaticheskoĭ zapis'iu spektra.** [Spectroelectrophotometer with automatic recording of the spectrum.] *Akademiia Nauk Kazakhskoĭ SSR. Astrofizicheskiĭ Institut, Izvestiia*, 8:108–114, **1959.** 5 figs., table, 6 refs., eqs. English summary p. 114. **DLC**—The author describes the construction and operation of a spectro-electrophotometer with automatic writing of spectrum (from λ4000 to λ7300A). An investigation of distribution of energy and polarization in the spectrum of the day sky was

carried out with this apparatus. *Subject Heading:* **1. Spectroelectrophotometers.**—*Author's abstract.* Ⓢ

11.12–30 525.723 551.521.3:551.501.721:551.508.762

Boĭko, P. N.; Livshits, G. Sh. and Toropova, T. P., **Prozhektornye issledovaniia indikatris rasseianiia.** [Searchlight investigation of scattering coefficients.] *Akademiia Nauk Kazakhskoĭ SSR. Astrofizicheskiĭ Institut, Izvestiia*, 8:98–107, **1959.** 5 figs., 3 tables, 4 refs., 2 eqs. English summary p. 107. **DLC**—The measurements of the light scattering functions were made by means of the photoelectric method. A special photometer was constructed. The receiver part of this photometer was photomultiplier connected with the valve amplifier of the constant current. With the help of this photometer measurements of the light scattering function were made in the bottom layer of the atmosphere in the spectral region 520 mμ. *Subject Headings:* **1. Searchlight techniques 2. Atmospheric scattering 3. Scattering coefficient.**—*Authors' abstract.* Ⓢ

11.12–31 525.723 551.593.5/7:551.510.522

Toropova, T. P., **Nekotorye rezul'taty izmereniĭ indikatris rasseianiia i poliarizatsii sveta v prizemnom sloe atmosfery.** [Some results of measurements of coefficients of scattering and polarization of light in the atmospheric layer near the ground.] *Akademiia Nauk Kazakhskoĭ SSR. Astrofizicheskiĭ Institut, Izvestiia*, 9:108–117, **1959.** 4 figs., 3 tables, 10 refs., 2 eqs. English summary p. 117. **DLC**—In this paper the results of determination of the absolute scattering functions and polarization of the light in the bottom layer of the atmosphere are given. A determination of the absolute function of light scattering provide a means for separating the aerosol component of the scattering. Limits of the change of asymmetry of the scattering function are given for some days of the observations. The data on the degree of polarization at different angles of scattering are given in tables. Knowledge of the absolute scattering function and the degree of polarization at different angles of scattering makes it possible to divide the function of scattering into two components, polarized and not polarized. *Subject Headings:* **1. Polarization measurements 2. Scattering of light.**—*Author's abstract .* Ⓢ

11.12–32 551.510.535:523.164.42

Chivers, H. J. A. (*Univ. of Manchester*), **The simultaneous observation of radio star scintillations on different radio-frequencies.** *Journal of Atmospheric and Terrestrial Physics*, London, 17(3):181–187, Feb. **1960.** fig., 2 tables, 14 refs. **DLC**—A comprehensive study of the phenomenon of radio star scintillation has been made over the range 26 Mc/s to 408 Mc/s, by recording simultaneously on at least two frequencies within this frequency range. With records obtained over a wide range of scintillation conditions, it has been possible to test the theoretical laws governing the frequency dependence of scintillation amplitude and rate. It is established that under extreme conditions these laws no longer hold. A study of the probability amplitude distribution of scintillations covers a wide range of mean scintillation amplitudes. The smaller scintillations have a Gaussian or Rayleigh amplitude distribution, but with increasing scintillation activity, discontinuities appear in the distribution obtained. Under the most intense conditions a net attenuation of the source is observed. The cross-correlation coefficient between records has been determined over a frequency ratio of 3:1 and the results are compatible with those of other workers. *Subject Heading:* **1. Radio star scintillation.**—*Author's abstract.* Ⓢ

11.12–33 525.722:523.164.42

Chivers, H. J. A. (*Jodrell Bank, Univ. Manchester*), **Observed variations in the amplitude scintillations of the Cassiopeia (23N5 A) radio source.** *Journal of Atmospheric and Terrestrial Physics*, London, 19(1):54–64, Sept. **1960.** 10 figs., 2 tables, 6 refs. **DLC**—Continuous monitoring of the radio source in Cassiopeia (23N5A) on a frequency of 79 Mc/s has made possible an analysis of the variations of radio star scintillations observed from Jodrell Bank (latitude 53°N). Monthly average daily variations are presented as functions of solar time, and the mean daily variations averaged over a year are evaluated as functions of both solar and sidereal time. An effect due to the geomagnetic latitude at which the observations were made, is demonstrated. Since records are available for over 4 years, the variations of scintilla-

tions with the sunspot cycle has been studied, and it has been found that in years of high solar activity scintillations show a strong seasonal dependence with maximum activity at the equinoxes. When examined over this long period, there is a strong negative correlation between scintillations and the occurrence of spread-F echoes. Evidence has been obtained that the angular size of the Cassiopeia source is sufficiently large to produce scintillations different from those expected of a point source. *Subject Headings:* **1. Radio star scintillation 2. Cassiopeia radio source.**—*Author's abstract.* Ⓢ

11.12–34 525.722:523.164.42

Jones, I. L. (*Cavendish Lab., Cambridge*), **Further observations of radio stellar scintillation.** *Journal of Atmospheric and Terrestrial Physics*, London, 19(1):26–36, Sept. **1960.** 6 figs., 17 refs. **DLC**—Observations are described of the scintillation of the radio signal received from the radio star in Cassiopeia on a frequency of 38 Mc/s. Further experimental results are presented to support SPENCER's (1955) evidence that the irregularities responsible for the radio stellar scintillation are elongated with their long axes along the lines of force of the earth's magnetic field. An estimate of the size of the irregularities in the ionosphere is made, and a marked decrease in the long axis of the irregularities is found as the elevation of the radio source decreases. Evidence is put forward which suggests that turbulence is unimportant on most occasions in the region responsible for the scintillation. *Subject Headings:* **1. Radio star scintillation 2. Cassiopeia radio source.**—*Author's abstract.* Ⓢ

11.12–35 525.722 551.593.12:523.164.42

Ryan, W. D. (*Queen's Univ., North Ireland*) and Harrower, G. A. (*Queen's univ., Kingston, Ontario*), **An apparent solar periodicity in radio star scintillation.** *Canadian Journal of Physics*, Ottawa, 38(6):883, June **1960.** fig., 2 refs. **DWB, DLC**—The radio sources Cassiopeia-A, Cygnus-A, Taurus-A, and Virgo-A were observed at upper culmination from the Radio Observatory of Queen's University, Kingston, Ontario, from the beginning of December 1957 to the end of November 1958. An auto—correlation function was calculated for the scintillation index for Cygnus-A. The results of the calculation indicate that solar activity contributes directly to the ionospheric processes responsible for the scintillation of radio stars, at least at locations in or near the auroral zone. *Subject Headings:* **1. Radio star scintillation 2. Solar-ionospheric relationships.**—*I.S.* Ⓢ

4. RADIO ASTRONOMY

A. General

11.12–36 523(02) 523.164

†Davies, Rodney Deane and Palmer, H. P., **Radio studies of the universe.** Foreword by A. C. B. Lovell. Princeton, N. J., Van Nostrand, **1959.** 200 p. figs., photos, bibliog. p. 189–192. **DLC** (QB475.D3). Review in *Weather*, London, 14(11):370, Nov. **1959.**—This book written for the "intelligent nonscientist" contains a discussion of astronomy and an outline of optical astronomy. In addition to the chapters on radio methods of observation, studies of radio sources, the radio universe, radio waves from the milky way and the sun, it contains explanations on exploring the planetary system with radar and probing the Earth's high atmosphere. An appendix provides the reader with a brief explanation of basic concepts such as the Doppler shift, blackbody radiation, and the Faraday effect. Finally a glossary of terms used in context is included. Separate bibliography for each chapter. *Subject Heading:* **1. Radio astronomy textbooks.**—*E.Z.S.* Ⓢ

11.12–37 523.164

Emberson, Richard M. (*Nat'l Radio Astronomy Obs., Green Bank, W. Va.*), **Radio astronomy and the new national observatory.** *New York Academy of Sciences, Transactions*, Ser. 2, 22(6):419–425, April **1960.** 7 refs. **DLC**—After surveying astronomical observations from ancient ages, JANSKY's discovery of radio signals from celestial sources at the Bell Telephone Laboratories at Holmdel, N. J. in 1932, is appraised as the starting landmark of radio astronomy. Comparing the importance of the difference in wave lengths between visual and

radio astronomy the advantage of radio techniques for the measurement of wave lengths or frequencies, and that of visual instruments for measuring the angular position of a celestial source are discussed. The absorption of electromagnetic radiations of certain wave lengths and the transparency for others, and the weakness of radio signals from celestial sources are discussed. The first true radio telescope built by GROTE REBER in the decade following JANSKY's discovery, radio astronomy programs, particularly in Australia, England, and the Netherlands during the last decade are mentioned. Of past results and future problems the author considers the following: if the sun were removed to the distance of the nearer stars we should not be able to detect solar radio emissions with present equipment; where identification of radio sources observable visually have been made, the object usually involves dust or gas clouds in violent motion; the emission of gas at a radio wave length of about 8 in is characteristic of hydrogen; radio astronomy can penetrate deeper into the universe than visual observations; the invention of traveling-wave tubes, parametric devices and the maser promise improvement in receiver performance. Some of the most advanced radio astronomy observatories operating at present are briefly described. *Subject Headings:* **1. Radio astronomy.** —*O.T.* Ⓢ

11.12–38 522.1:523.164

Struve, Otto (*Nat. Radio Astron. Obs., Green Bank, W. Va.*), **The National Radio Astronomy Observatory: the outlook in 1960.** *Astronomical Society of the Pacific, San Francisco, Publications*, 72(426):177–187, June **1960.** 3 refs. **DLC**—This report reviews the progress of the National Radio Astronomy Observatory since 1956 and makes suggestions relating to its future expansion. The Observatory has been successful in attracting a number of graduate students and young scientists for short terms to work with the 85-foot telescope. In view of the growing interest, however, the present facilities are not adequate. In the context of future expansion the need for the construction of a very large antenna, with an aperture of the order of 2000 ft., is especially emphasized. *Subject Headings:* **1. Radio astronomy observatories 2. Green Bank, W. Va.**—*I.S.* Ⓢ

11.12–39 523.164:551.507.362.2:621.396.8:551.510.535

Lovell, A. C. B. (*Jodrell Bank Experimental Station*), **Radio astronomical measurements from earth satellites.** *Royal Society of London, Proceedings, Ser. A*, 253(1275):494–500, Dec. 29, **1959.** 3 figs., 16 refs. **DWB, DLC**—It may be thought that radio astronomical measurements made on the earth are not subject to the influence of the atmosphere and ionosphere to any great extent and that consequently there is no demand for measurements from earth satellites or other space stations. Unfortunately this is not the case and certain measurements from outside the earth's atmosphere are very much desired. The radio spectrum so far explored extends from a low frequency limit in the 10 to 20 Mc/s band, to an upper limit in the millimeter waveband. In the millimeter band the limitation to the extension of the spectrum arises from absorption bands in the atmosphere, whereas at low frequencies the extension is limited by absorption and disturbances in the ionosphere. In this paper some examples are given of the need to overcome these obstacles. *Subject Headings:* **1. Satellite uses 2. Radio astronomy measurements.**—*Author's abstract.* Ⓢ

B. INSTRUMENTS

See also: **Photooptical, electronic and calibration apparatus** (Nardonne), 11.12–196.

11.12–40 523.164.08

Müller, Hans-Gerhard, **Messmethoden in der Radioastronomie.** [Measurement methods in radio astronomy.] *Zeitschrift für Instrumentenkunde*, Brunswick, 68(6):117–124, June **1960.** 16 figs., 6 refs. **DWB**—Today radio astronomy is an independent branch of science. Although the aims are essentially similar to those in optical astronomy, different techniques are required in the radio range. The fundamental problems and measuring procedures are dealt with in this review. *Subject Headings:* **1. Radio astronomy 2. Radio astronomy techniques.**—*Author's abstract.* Ⓢ

11.12–41 523.164.08

Rougoor, G. W., **Een radiotelescoop met een middelijn van 180 meter.** [A radio telescope with a 180 m diameter.] *Hemel en Dampkring*, The Hague, 58(2):25–29, Feb. **1960.** 2 figs. **DWB, DLC**—A description of the radio telescope of the Naval Research Laboratory at Washington. The author gives a list mentioning the most important radio telescopes in the world. The radio telescope is entirely controlled by punched cards, and is collecting information also on punched cards. By this telescope it is possible to perform 1) research on radio impulse 10 cm waves 2) observation on radio impulse sent from the telescope to a planet and reflected by the planet 3) research in the field of interstellar gases. *Subject Headings:* **1. Radio telescopes 2. U. S. Naval Research Laboratory.**—*A.V.* Ⓢ

11.12–42 523.164.08

McClain, Edward F., Jr., **The 600-foot radio telescope.** *Scientific American*, N. Y., 202(1):45–51, Jan. **1960.** 6 photos. **DWB, DLC**—The construction of a giant telescope in West Virginia is described. The instrument will be valuable in the studies of the solar system and will be able to follow single spots on the sun if they are far enough apart. Radar echoes will be especially useful in studies of the sun and its corona. They hope to find phenomena to give radio astronomy a distance scale. Diagram and photographs of the telescope are included. *Subject Heading:* **1. Radio telescopes.**—*A.H.K.* Ⓢ

11.12–43 523.164.08

Tanaka, Haruo, **An 8-element interferometer at 9400 Mc/s.** *Nagoya. Univ. Research Institute of Atmospherics, Proceedings*, 6:67–68, Jan. **1959.** photo, 3 refs. **DWB**—Since the distribution of polarized components on the solar disk at 9400 Mc/s differs considerably from those of the interferometer at 4000 Mc/s used in the past 6 years, an interferometer with the former capacity was constructed and is described and illustrated here. *Subject Headings:* **1. Interferometers 2. Solar radio emissions.**—*W.N.* Ⓢ

11.12–44 523.164.08:551.507.362.2

Tyas, J. P. I.; Franklin, C. A. and Molozzi, A. R., **Measurement of cosmic noise at low frequencies above the ionosphere.** *Nature*, London, 184(4689):785–786, Sept. 12, **1959.** 9 refs. **DWB**—The paper reports a 2–15 Mc/s-swept frequency ionosphere sounder, being designed at present under the auspices of the Canadian Defence Research Board, in cooperation with the National Aeronautics and Space Administration, to be launched as an Earth satellite. The practicability of this device for measurement of cosmic noise is discussed. *Subject Headings:* **1. Cosmic radio noise measurement technique 2. Satellite radio noise measurement.** —*I.S.* Ⓢ

c. Radio Emissions from the Sun

See also: **Interferometer at 9400 Mc/s** (Tanaka), 11.12 43; **Properties of white light jets of solar corona** (Dollfus), 11.12-111; **Continuous solar emission** (Kazachevskaia, Ivanov-Kholodnyĭ), 11.12–113.

11.12–45 551.506.22:523.164.32:551.510.535

Bazzard, G. H. (*DSIR Radio Res. Station, Slough*), **Short-term differences in the behaviour of two daily indices of solar activity during the IGY.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(4):290–296, Aug. **1960.** 2 figs., 4 tables, 13 refs., eq. **DLC**—The variations in the daily values of the flux of solar radio noise at λ10.7 cm (Φ) and the E-layer character figure (J_E) have been studied for the period of the IGY. It is found that Φ lags behind J_E by about 14 hr. The ratio J_E/Φ fluctuates above and below its normal value and the reasons for these changes have been examined. Troughs in J_E/Φ are attributed partly to increases in geomagnetic activity which cause a decrease in J_E, and partly to the presence of active regions on the sun's disk which tend to emit relatively more radio noise than the quiet sun. Peaks in J_E/Φ are associated with the absence of these active areas. *Subject Headings:* **1. Solar radio noise data 2. IGY solar activity program.**—*Author's abstract.* Ⓢ

11.12–46 523.164.32:523.75

Boischot, A. and Warwick, J. W. (*both, High Altitude obs., Univ. of Colorado*), **Radio emission following the flare of Aug. 22, 1958.** *Journal of Geophysical Research*, Wash., D. C., 64(6):683–684, June 1959. 2 figs., ref. **DWB, DLC** –An evaluation of the radio emission on 18 and 40 Mc/s following the flare seen on the Sun on Aug. 22, 1958 is presented from the observations of the High Altitude Observatory, University of Colorado, taking into account the observations on 60 Mc/s from Harvard College Observatory, Fort Davis, Texas; on 169 Mc/s from Nancy, France; on 470 Mc/s from the National Bureau of Standards, Boulder, Colorado; and on 2800 Mc/s from Ottawa, Canada. A small flare, importance 1+, was in progress, when the great flare, importance 3 or 3+, appeared at 1417 UT, and this second flare was still continuing at 1700 UT. The radio emission showed an intense outburst, coinciding with the flare as illustrated on diagrams from $14^h\ 20^m$ to $16^h\ 20^m$ UT for 18, 40, 60, 169, 470 and 2800 Mc/s, uncorrected for antenna gain. The complete records on a smaller time base are corrected for the effect of lobe, and presented along with ANDERSON's 1958 cosmic ray data. The spectrum differed from that of typical outbursts observed after great flares, by the great intensities reached on 40 and 18 Mc/s. Two different types of emission are indicated: 1) the burst appearing on 2800 and 470 Mc/s with decreasing intensity and frequency disappears near 100 Mc/s; 2) a long enduring continuum appears later on frequencies lower than 200 Mc/s. The increase of cosmic rays corresponds better to this second part of radio emission. The type II emission on metric wavelengths, which generally immediately follows the flare, is very weak or non-existent. The probability of a group of type III bursts is suggested. *Subject Headings:* **1. Radio emission from sun 2. Solar flares.**—*O.T.* Ⓢ

11.12–47 523.164.32 621.396.8:523.75

de Feiter, L. D.; Fokker, A. D. and Roosen, J., **Association of radio outbursts with solar flares.** *Nature*, London, 184(4689) Supp. No. 11:805–806, Sept. 12, 1959. 2 tables, 3 refs. **DWB**—The reported investigations were carried out at the Ionosphere and Radio Astronomy Section Netherlands Postal and Telecommunications Services, The Hague. Mean frequencies of occurrences of radio flares were derived in order to verify whether the association of outbursts with flares of a special type or belonging to a particular sequence is above or below normal. These figures were obtained by carefully comparing the records with the list of flares compiled by the Meudon Observatory. Relative frequencies of outburst associated flares, based on the data covering the period July 1957–December 1958, are also tabulated. It was found that certain sequences of flares originating in very much the same heliographic position, are distinctive for an abnormally great or for a very low production of outbursts, or for a special type of associated radio events. Two examples of such cases are presented. *Subject Heading:* **1. Radio noise burst—solar flare relationships.**—*I.S.* Ⓢ

11.12–48 523.164.32:523.755

de Jager, C. (*Sterrewacht Sonnenborgh, Utrecht*), **Optical and radiophenomena associated with a solar activity centre.** *Nuovo Cimento*, Bologna, Supplement No. 1 to Ser. 10, Vol. 13, 1959. p. 284–290. 2 figs., 3 tables. **DLC**—The fully developed corona as described by KIEPENHEUER in 1952 is discussed. The first part of the life history of an active center; the coronal extension of a moderately active corona; the coronal condensations and the flares; and the radioemission of flares are examined. Some other phenomena, pointing to high temperatures in the corona after a flare, are summarized. The radioemission of flares is illustrated and some of its properties as well as the time differences of cosmic radiation bursts reaching their maximum intensity after flares are tabulated. *Subject Headings:* **1. Corona structure 2. Radio emission from sun.**—*O.T.* Ⓢ

11.12–49 523.164.82:621.396.62

Elgarøy, Oystein (*Inst. of Theoretical Astrophysics, Univ. of Oslo*), **Observations of the fine structure of enhanced solar radio radiation with a narrow-band spectrum analyser.** *Nature*, London, 184(4690), Supp. No. 12:887 888, Sept. 19, 1959. 3 figs., 3 refs. **DWB**—A narrow-band swept receiver was set up at Harestua to study the pips of enhanced solar radio radiation. The operation of the receiver is explained and the observations are described.

On August 18 a very remarkable fine structure was found in the 200 Mc/s radiation. The observations of storm bursts are discussed and shown in 3 photographs. *Subject Headings:* **1. Solar radio noise bursts 2. Solar radio emissions 3. Spectrum analyzers.**—*I.S.* Ⓢ

11.12–50 523.164.84:523.755

Erickson, W. C. (*Convair Sci. Res. Lab., San Diego, Calif.*), **Radio emission in the outer corona.** *Physical Review Letters*, N. Y., 3(8):365–367, Oct. **1959.** fig., 5 refs. **DLC**—The transit observations of the sun obtained at a frequency of 26.3 Mc/sec at Clark Lake radio astronomy station during May, June, and July, 1959 are reported. The observations were made with a fan-shaped beam oriented along the local meridian. The results of the observations showing the time at which the radio sun transited the local meridian, are graphically represented. Reportedly a clean series of observations was obtained during the period from May 8 to 19, which apparently occurs on rare occasions. *Subject Headings:* **1. Coronal emission data 2. Radio emission from sun 3. Radio astronomy measurements.**—*I.S.* Ⓢ

11.12–51 523.164.82

Gerson, Nathaniel C. (*Arctic Comm. U. S. Nat'l Comm. IGY*) **Periodicities in solar radio noise emission.** *Australian Journal of Physics*, Melbourne, 12(3):299–300, Sept. **1959.** fig., table, 4 refs. **DLC**—A note indicating the presence of sweeper trains in the work of ROBERTS (1958) in which he described solar radio wave emissions in the range 40–80 Mc/s. In a reproduction of his Figure I the elements of several sweeper trains (A-E) are indicated. Periods of the trains are tabulated. *Subject Heading:* **1. Solar radio noise.**—*I.S.* Ⓢ

11.12–52 523.164.82 551.521.67:621.396.8

Giovanelli, R. G. (*Commonwealth Scient. Ind. Research Org., Sydney*), **Solar disturbances producing type II radio bursts.** *Nuovo Cimento*, Bologna, Supplement No. 1 to Ser. 10, Vol. 13, **1959.** p. 299–301. table, 3 refs. **DLC**—The analysis of this phenomenon supported by a table showing the number of cases of possible causes derived from observations at Commonwealth Scientific Research Organization, Sydney during 1956–1957 concluded in asserting the following reactions: 1) particle streams of different origins can stimulate the bursts; 2) the stream had velocities exceeding that of the sound in the corona in all limb events; the fundamental plasma frequency escapes from much nearer the limb than expected on the basis of a spherically symmetrical corona. *Subject Headings:* **1. Solar radio noise bursts 2. Solar disturbances.**—*O.T.* Ⓢ

11.12–53 523.164.82:551.510.535:551.594.12

Hachenberg, O. and Volland, H., **Vergleich zwischen 3.2 cm-Radiostrahlung der Sonne und ionosphärischer Dämpfung im D-Gebiet während einer Sonneneruption.** [Comparison between 3.2 cm radio emission from the Sun and ionospheric dampening in the D layer during a solar eruption.] *Zeitschrift für Astrophysik*, Berlin, 47(2):69–80, **1959.** 4 figs., table, 12 refs., 24 eqs. **DLC**—The time variation of the nondeviative absorption in the ionospheric D layer during a sudden ionospheric disturbance (Mögel-Dellinger-effect) is compared with the radio burst on 3.2 cm wavelength caused by the corresponding solar flare. Using the continuity equation for the ionospheric electron density, the intensity variation of the ionizing radiation can be determined. It is found that this intensity variation is in qualitative agreement with the intensity variation of the 3.2 cm emission. Thus the hypothesis is strongly supported, that the 3.2 cm emission and the ionizing radiation responsible for the D layer both originate from the same gaseous volume in the solar atmosphere, and are both generated by similar emission mechanisms. *Subject Headings:* **1. Radio noise bursts 2. Solar radio emissions 3. D layer ionization 4. Ionospheric disturbances 5. Solar eruption effects on ionosphere.**—*Authors' abstract.* Ⓢ

11.12–54 521.164.32:523.746

Hauge, Øivind, **Variations in the solar base level radiation on 200 Mc/s.** *Astrophysica Norvegica*, Oslo, 6(11):123–130, Jan. **1960.** 3 figs., 10 refs. **DWB**—The thermal base level emission from the sun in the 200 Mc/s range shows a primary intensity variation which is

closely connected with the sunspot cycle. The base level radiation at sunspot maximum is on the average about twice the flux magnitude at sunspot minimum. Small, secondary variations in the emission do not seem to originate in areas on the sun giving enhanced noise storm emission, but appear to be caused by local sources of enhanced temperature in the corona. *Subject Heading:* **1. Solar radio emissions.**—*Author's abstract.* Ⓢ

11.12–55 523.746:523.164.32

Maltby, Per (*Univ. of Oslo*), **Correlation between the intensity of the umbra of sunspots and enhanced radiation on 200 Mc/s.** *Nature*, London, 184(4696, Supp. No. 18):1391, Oct. 31, 1959. fig., ref. **DWB**—The excessive solar radiation at meter wave lengths originates within a restricted area of the corona above a sunspot. The position of radio sources shows the existence of sunspots at the time of excessive radiation. By finding out characteristics of noise-active sunspots more information about the generation mechanism can be derived. J. Konn (*Astro. Nacht.* 270, 105, 1940) has described the method to correct the measurements of intensity of umbra. By observing the relative intensity of umbra and penumbra, we can determine the degree of correlation between intensity of the umbra and the noise activity of the sunspots. The correlation is very slight between noise activity and area of the sunspot for areas exceeding 400 millionths of the solar hemisphere. *Subject Headings:* **1. Sunspot radio radiation 2. Solar radio emissions.**—*A.H.K.* Ⓢ

11.12–56 551.521.67:523.753:621.396.8 523.164.32

Pick-Gutmann, Monique, **Sur la structure des types IV: les orages continuum.** [The structure of type IV jumps: the continuum storms.] *Académie des Sciences, Paris, Comptes Rendus*, 250(12):2127–2129, March 21, 1960. 2 figs., 7 refs. **DWB, DLC**—One distinguishes two phases in the evolution of the type IV jumps. In the first phase, the duration of which seldom exceeds a quarter of an hour, the continuous radiation always occurs on centimeter or decimeter waves. In the second phase, the continuum occurs essentially on meter waves; this emission may last from some tens of minutes to 1 or 2 days in exceptional cases. This second phase resembles radioelectric storms by both its duration and its spectrum. The 24 hr continuums present a set of characteristics which seem to define a class of distinct phenomena called by the author continuum storms. These are always preceded by a very important chromospheric eruption and by a very intense first phase. It is difficult to specify whether the continuum storm is to be considered as a transformation of the first phase of the type IV jump or as an independent phenomenon linked also with the chromospheric eruption. *Subject Headings:* **1. Solar radio emissions 2. Solar radio noise 3. Chromospheric eruptions 4. Radioelectric storms 5. Continuum storms.**—*A.V.* Ⓢ

11.12–57 523.164.82:523.164.32:550.388

†Roberts, J. A. (*Div. of Radiophysics, C. S. I. R. O., Univ. Grounds, Chippendale, N. S. W.*), **Solar radio bursts of spectral type II.** *Australian Journal of Physics*, Melbourne, 12(4):327–356, Dec. 1959. 16 figs., 3 tables, 31 refs. **DLC**—The characteristics of bursts of spectral type II are studied in a sample of 65 bursts. Approximately half the bursts show harmonic structure and about half are compound type III-type II events. Band splitting, the doubling of both the fundamental and second harmonic bands, is also relatively common. A rather less common feature is the appearance of herring-bone structure in which the slowly drifting band of the type II burst appears to be a source from which rapidly drifting elements diverge towards lower and higher frequencies. Statistics are given of the rate of occurrence of the bursts, their frequency range, the rate of frequency drift, and the harmonic ratio. Many of the type II bursts occurred near or after the maximum of a chromospheric flare. However only about 3 per cent of flares (of Class I or greater) are accompanied by type II bursts, although the figure rises to 30 per cent for Class 3 flares. There is a greater tendency for the geomagnetic field to be disturbed in the few days following a type II burst than there is after large flares which are not accompanied by type II bursts, or after large radio bursts of spectral type III. Statistically the greatest disturbance occurs after about two days, implying a mean speed of travel of about 1000 km/sec. *Subject Headings:* **1. Solar radio noise bursts 2. Solar flares 3. Solar-geomagnetic relationships.**—*Author's abstract.* Ⓢ

11.12–58 523.164.32:621.396.67

Shain, C. A. and Higgins, C. S. (*both, Div. of Radiophysics, C. S. I. R. O., Univ. Grounds, Chippendale, N.S.W.*), **Location of the sources of 19 Mc/s solar bursts.** *Australian Journal of Physics*, Melbourne, 12(4):357–368, Dec. **1959.** 5 figs., 3 tables, 11 refs. **DLC**—By using large aerials in a new way, it has been possible to locate, with considerable accuracy, the sources of 19 Mc/s bursts. The positions of these sources have been correlated with the positions of optically active regions associated with them, and the radial distances of the radio sources from the centre of the Sun have been deduced. In 1950–1951, 18.3 Mc/s bursts came from sources at a radial distance estimated as $3.4R_0$; more reliable data in 1957 indicated that the sources of 19.7 Mc/s bursts were at a radial distance of $2.9R_0$. It is thought that these measurements give the distances of the fundamental plasma levels in coronal streamers. *Subject Heading:* **1. Solar radio noise bursts.**—*Authors' abstract.* Ⓢ

11.12–59 523.164.32:621.396.029

Tanaka, Haruo and Kakinuma, Takakiyo, **Sudden disappearance of a source of S component of solar radio emission at microwave frequencies on Nov. 30, 1959.** *Nagoya Univ. Research Institute of Atmospherics, Proceedings*, 7:72–78, Jan. **1960.** 6 figs., 2 refs. **DWB** (M(05) N152p)—A temporary marked decrease of microwave solar radio emission after a burst was observed at 1000, 2000, 3750 and 9400 Mc/s on November 30, 1959. Interferometric observations at 9400 and 4000 Mc/s show that the greater part of a strong source of slowly varying component of solar radio emission disappeared temporarily. In this paper the results of radio observations are described. The temporary disappearance of the radio source may be considered to be due to the absorption of radiation by the overlying surge-like material. *Subject Headings:* **1. Solar radio emissions 2. Microwave absorption 3. Solar radio noise bursts.**—*Authors' abstract.* Ⓢ

11.12–60 523.164.82:551.521.67

Thompson, A. R. and Maxwell, A., **Solar radio bursts and low-energy cosmic-rays.** *Nature*, London, 185(4706):89–90, Jan. 9, **1960.** fig., table, 10 refs. **DWB, DLC**—This paper considers the radio spectral observations of the sun, and from this elucidates the origin of the solar protons of energies 30–300 MeV and their relation to solar radio bursts, flares, and terrestrial disturbances. The data consists of a continuous record of solar radio bursts obtained from sunrise to sunset for the past three years at the Harvard Radio Astronomy Station, Fort Davis, Texas, with sweep frequency receivers covering the range 25–580 Mc/s. *Subject Headings:* **1. Solar bursts 2. Solar protons 3. Fort Davis, Texas.**—*I.S.* Ⓢ

11.12–61 523.75:523.164.32

Waldmeier, M., **Radioheliogramme und Koronaintensität.** [Radioheliograms and coronal intensity.] *Zeitschrift für Astrophysik*, Berlin, 48:163–171, **1959.** 4 figs., 9 refs. English summary p. 163. **DLC**—Reprinted as *Zürich. Eidgenössische Sternwarte, Astronomische Mitteilungen*, No. 225. **DLC**—A comparison is made between two-dimensional radioheliograms and optical observation of the corona in the line 5303 A. As both these observations refer to the same level of about 20–50,000 km above the photosphere, a close connection between the source regions of the radio and the optical coronal radiation may be expected. It is shown that in general the optical coronal emission indeed reveals a better conformity with radiosources than sunspots and plages. If, however the connection is not satisfactory in every respect, we have to consider that the radioheliogram represents an instantaneous picture, whereas the coronal map has to be built up from observations extending over several days. For further discussions coronal observations of the emission lines as well as of the continuum made at different heights are urgently needed. *Subject Headings:* **1. Solar radio emissions 2. Coronal emission data.**—*Author's abstract.* Ⓢ

11.12–62 523.75:523.164.82

Wild, J. P.; Sheridan, K. V. (*both, C. S. I. R. O., Univ. Grounds*) and Neylan, A. A. (*Mt. Stromlo Obs., Canberra*), **An investigation of the speed of the solar disturbances responsible for type III radio bursts.** *Australian Journal of Physics*, Melbourne, 12(4):369–398, Dec. **1959.** 16 figs., 18 refs., 11 eqs. **DLC**—The paper describes an investigation aimed at finding

out whether solar radio bursts of spectral type III are due to disturbances which travel out through the corona with velocities exceeding 0.1 c, as predicted by the well-known hypothesis that the emissions are due to plasma oscillations. If the proposition is correct, emissions at different frequencies would be generated at different levels in the corona—the lower the frequency the higher the source. This property is tested by simultaneous directional observations at a number of frequencies between 40 and 70 Mc/s, using a swept frequency interferometer. The system and performance of the interferometer are described and errors in position finding due to ionospheric refraction are discussed. Results for type III bursts show that different frequencies are generated at different levels in the corona according to the predicted sequence; they therefore strongly support the plasma hypothesis. It is concluded that the corona is considerably denser in the regions where type III sources are generated than in the average corona as depicted by conventional models; and an origin in coronal streamers is suggested. The derived velocities of type III disturbances are found to be considerably greater than those previously deduced from spectral data alone. The range of velocities now inferred extends from 0.2 c to 0.8 c, with an average of 0.45 c. The significance of these very high velocities is discussed. For this purpose new evidence is discussed relating to the "type V" continuum emission which follows certain type III events. The combined type III–V events, which are known to correlate closely with chromospheric flares and sub-flares, are interpreted in terms of streams of relativistic electrons with energies $\gtrsim$MeV which travel along magnetic lines of force in spiral paths. It is suggested that, in its outward passage, such a stream excites plasma oscillations in the surrounding coronal gas (yielding the type III burst), while, under favorable circumstances, the electrons themselves emit synchrotron radiation (yielding the type V burst). A possible connection between the energetic solar electrons and the corpuscular radiation surrounding the Earth is suggested. *Subject Headings:* **1. Solar radio noise bursts 2. Solar disturbances.**—*Authors' abstract.* Ⓢ

d. Radio Emissions from Planets

11.12–63 523.164.3:523.4

Schmidt, H., **Planetarische Radiostrahlung.** [Radio emission from planets.] *Die Sterne*, Leipzig, 36(3/4):81–83, March/April **1960. DLC**—In agreement with the 101st session of the American Astronomical Society a symposium was organized in December 1958 at Gainesville. The author shows the observations made in the field of radio astronomy by K. L. Franklin, B. Bwike, H. Tatel, T. D. Carr and others. From the results of various research works the conclusion was reached that besides the sun, only Jupiter may be considered as a radio source; Venus, Saturn and the comets need a more developed research. The author gives some results of measurements: (Venus) by Meyer—3.15 cm and 3.4 cm wave; (Jupiter) by MacClain and Sloanaker—10.3 cm. Observations of Saturn in 1958 have been without results. *Subject Headings:* **1. Radio astronomy 2. Radio emission from planets.**—*A. V.* Ⓢ

11.12–64 523.164.34

Amenitskiĭ, N. A.; Noskova, R. I. and Salomonovich, A. E. (*all, P. N. Lebedev Physical Inst., Academy of Sciences, USSR*), **Radio image of the moon at 8 mm.** *Soviet Astronomy AJ*, New York, 4(1):177–178, July/Aug. **1960.** fig., 3 refs. **DLC.** Transl. of **Radioizobrazhenie Luny v 8-millimetrovom diapazone.** *Astronomicheskiĭ Zhurnal*, Moscow, 37(1):185–186, Jan./Feb. **1960. DLC**—A report on the two-dimensional distribution of radio brightness of the moon in the 8-mm range, obtained using the 22-meter radio telescope of the Physical Institute. A noticeable phase dependence of the radio-brightness distribution, lagging the phase variation of the moon by ~30°, was noted. Limb darkening was also recorded. *Subject Heading:* **1. Radio emission from moon.**—*Authors' abstract.* Ⓢ

11.12–65 523.164.352

Kraus, J. D. (*Radio Obs., Ohio State Univ., Columbus, Ohio*), **Apparent radio radiation at 11-m. wave-length from Venus.** *Nature*, London, 186(4723):462, May 7, **1960.** 3 refs. **DWB**—A critical review of preliminary communications referring to the reception of 11-m radiation from the planet Venus in 1956. The author's conclusion is that to determine the existence or nonexistence of such radiation beyond any doubt, further observations are needed

using a better equipment than was available in 1956. *Subject Headings:* **1. Radio emission from planets 2. Venus.**—*E.K.* Ⓢ

11.12–66 523.164.355 535.51:551.521.3:523.4

Radhakrishnan, V. and Roberts, J. A. (*both, Radio Observatory, Calif. Inst. of Technology*) **Polarization and angular extent of the 960-Mc/sec radiation from Jupiter.** *Physical Review Letters*, N. Y., 4(10):493–494, May 15, 1960. table, 7 refs. **DLC**—If the emission of intense 10-cm radiation from Jupiter has its origin in a "Van Allen belt" surrounding Jupiter, the angular extent of the source of the radiation is likely to be several times the diameter of the planet. Some degree of polarization of the radiation would be expected. These predictions are being tested with a variable-spacing interferometer, and some results are reported. The source is strongly linearly polarized, the radiation with the electric vector parallel to the equatorial plane of the planet being approximately 1.7 times as intense as in the orthogonal polarization. The radiation comes from a region several times the diameter of the disk and is more strongly polarized in the outer parts. *Subject Headings:* **1. Radio emission from planets 3. Jupiter.**—*E.Z.S.* Ⓢ

11.12–67 523.164.355

Field, George B. (*Princeton Univ.*), **The source of radiation from Jupiter at decimeter wavelengths, Pt. 2, Cyclotron radiation by trapped electrons.** *Journal of Geophysical Research*, Wash., D. C., 65(6):1661–1671, June 1960. 4 figs., table, 21 refs., 30 eqs. **DLC** -One of the mechanisms suggested in a previous paper which could account for the decimeter radiation from Jupiter is examined in detail. A model is proposed in which nonrelativistic electrons are trapped on a magnetic surface in Jupiter's magnetic field, in analogy with the outer radiation belt of the earth. The spectrum and polarization of the cyclotron radiation emitted as the electrons move through the inhomogeneous magnetic field are calculated. The form of the spectrum ($\lambda^{\frac{1}{2}}$) compares well with the observed one, and the required electron densities are only 0.3 percent of those observed in the belt around the earth. The required magnetic field is very large—at least 1200 gauss at the poles. It is found that the polarization of the 20-Mc/s bursts can be explained if the latitude of the emitting region is between 30° and 40°. A suggestion is made about the origin of those bursts in electrical discharges. It is shown that the large magnetic field may be primordial, owing to the high electrical conductivity throughout the planet. Observational tests related to the proposed mechanism are discussed. (For Pt. 1 *see* 11.9–90, Sept. 1960, *Met. Abstr.*) *Subject Headings:* **1. Jupiter 2. Radio emission from planets.**—*Author's abstract.* Ⓢ

E. Radio Emissions from Outside the Solar System

See also: **Radio star scintillation** (Chivers; Jones; Ryan), 11.12–32 to 11.12–35.

11.12–68 523.164.4:551.510.535

Ramanathan, K. R. and Bhonsle, R. V. (*both, Physical Res. Lab., Ahmedabad, India*), **Cosmic radio noise absorption on 25 Mc/s and F scatter.** *Journal of Geophysical Research*, Wash., D. C., 64(10):1635–1637, Oct. 1959. fig., 4 refs. **DLC**—An evaluation of the mean diurnal and seasonal variations of the attenuation of cosmic radio noise in the atmosphere is attempted. The features examined are: minimum attenuation occurs before sunrise; daytime maximum near afternoon; a second maximum usually between 20 and 22 hours, "in the winter equinoctial and months". D region absorption and F region absorption in the ionosphere were separately estimated. D region absorption depends directly on solar zenith-distance. The deviate F region attenuation was evidently connected with F scatter. This view is strongly supported by observations of Bateman and others in the Philippines-Okinawa area during IGY. The frequency of evening enhancements reached a peak during each equinoctial period, operating at 36.4 Mc/s. The peak at autumn could be observed during operations at 49.84 Mc/s only. Bateman and his coauthors suggested that the enhanced signal was propagated vis the F region, and was enhanced when there was low latitude spread F. The authors of the present paper believe that ion clouds in the F region can increase the scattered VHF signal strength from a ground transmitter, and attenuate at the same time the noise signals from

extraterrestrial noise sources. The decrease of cosmic noise absorption on 25 Mc/s at Ahmedabad, on days with magnetic storms, correlates with the absence of F scatter on magnetically disturbed days in low latitudes. The diagrams show the monthly mean hourly values of total attenuation; D absorption and an F2 attenuation of cosmic radio noise on 25 Mc/s at Ahmedabad. *Subject Headings:* **1. Cosmic radio frequency radiation 2. Ionospheric attenuation of cosmic radio noise.**—*O.T.* Ⓢ

11.12–69 523.164.42

Grahl, B. H. and Priester, W., **Eine Messung der Position der Radioquelle Sagittarius A.** [Position measurement of the radio source Sagittarius A.] *Zeitschrift für Astrophysik*, Berlin, 47(1):50–53, **1959.** fig., 12 refs., eqs. **DLC** (QB1 Z4)—At the International Astronomical Union Congress in 1958, the authors gave tentative figures for the position of Sagittarius A as: $\alpha = 17^h\ 43^m 8^s.6\ \delta = -28°47'.2$. After correcting for telescope error they determined the position as: $\alpha = 17^h\ 43^m\ 7^s.9 + 4^s.0\ \delta = -28°57'.9 \pm 1'.0$. The proper (corrected) galactic coordinates (Ohlsson-Pol) are: $l = 327°40'.7 = 327°.68 \pm 0°.02$; $b = -1°27.2 = -1°.45 \pm 0.02$. *Subject Headings:* **1. Sagittarius A radio source position 2. Radio stars.**—*E.Z.S.* Ⓢ

11.12–70 551.521.64:523.88:523.164.42

Savedoff, M. P. (*Dept. Physics, Astron. Univ. Rochester, N. Y.*), **The Crab and Cygnus A as gamma ray sources.** *Il Nuovo Cimento*, Bologna, Ser. 10, 13(1):12–18, July 1, **1959.** 2 tables, 7 foot refs. Italian summary p. 18. **DLC**—The Crab is estimated to give a maximum nuclear γ-ray flux of 10^{-2} cm^{-2} s^{-1} from the decay of ^{251}Cf formed with ^{253}Cf during the supernova outburst. Although extrapolation of the radio and visual fluxes suggests the possibility of a flux as high as 10γ cm^{-2} s^{-1} between 1 and 2 MeV, model calculations suggest that $7.10^{-5}\gamma$ cm^{-2} s^{-1} above about 10 MeV is more probable. Bremsstrahlung and Compton scattering yield considerably lower fluxes. Cygnus A, regarded as the result of a collision of matter and antimatter, should yield lower fluxes than the γ cm^{-2} s^{-1} estimated by Morrison. The radio flux suggests a π^2 decay γ-flux of $4.10^{-5}\gamma$ cm^{-2} s^{-1}. For E > 10 MeV, any γ-ray flux exceeding $5.10^{-5}\gamma$ cm^{-2} s^{-1} should be detectable from a balloon flown emulsion stack. *Subject Headings:* **1. Cosmic gamma radiation 2. Gamma rays from galactic sources.**—*Author's abstract.* Ⓢ

11.12–71 551.521.64:523.88:523.164.42

Braccesi, A.; Ceccarelli, M. (*both, Istituto di Fisica, Univ. Bologna*) and Salandin, G. (*Istituto Nazionale di Fisica Nucleare*), **Search for γ radiation from the Cygnus A radiosource.** *Il Nuovo Cimento*, Bologna, Ser. 10, 17(5):691–694, Sept. 1, **1960.** fig., 5 foot refs. Italian summary p. 694. **DLC**—An experiment is described attempting to detect energetic γ-radiation from a peculiar celestial object (Cygnus A) interpreted by some authors as a collision between a galaxy of matter and one of anti-matter. The experiment was negative and settled as upper limit for the γ-flux a value of about 5.10^{-3} quanta/cm^2 s, which is about two orders of magnitude smaller than estimated by Morrison under the assumption previously mentioned. *Subject Headings:* **1. Cosmic gamma radiation 2. Gamma rays from galactic sources.**—*Authors' abstract.* Ⓢ

11.12–72 523.164.43

McGee, R. X. and Murray, J. D. (*both, Univ. Grounds, Chippendale, N. S. W.*), **Neutral hydrogen gas in the Taurus-Orion region observed with a multichannel 21 cm line receiver.** *Australian Journal of Physics*, Melbourne, 12(2):127–133, June **1959.** 4 figs., 8 refs., eq. **DLC**—A multichannel 21 cm hydrogen line receiver has been developed which is capable of producing a complete line profile in the very short time of 2 min. To evaluate the large-scale survey potential of the instrument, the Taurus and Orion regions of approximately 3500 square degrees have been observed with a low-resolution (2.8° between half-power points) paraboloid. The results suggest that a single large cloud or connected association of clouds of neutral hydrogen covers most of the region surveyed. *Subject Headings:* **1. Hydrogen lines 2. Radio astronomy surveys 3. Radio line receivers.**—*Authors' abstract.* Ⓢ

11.12–73 523.164.43:523.854

Kerr, F. J.; Hindman, J. F. and Gum, C. S. (*all, Div. Radiophysics C. S. I. R. O., Univ. Grounds, Chippendale, N. S. W.*), **A 21 cm survey of the Southern Milky Way.** *Australian*

Journal of Physics, Melbourne, 12(3):270–292, Sept. 1959. 15 figs., 41 plates, 2 tables, 16 refs. **DLC**—A study has been made of 21 cm hydrogen-line radiation around the Southern Milky Way, using a beamwidth of 1°.4 and a bandwidth of 40 kc/s (8.5 km sec). The surveyed strip of sky was sampled by recording the intensity of the radiation along 41 discrete tracks across the galactic equator, in the longitude range 175°–5° ("old" system of coordinates). The tracks were generally spaced 5° apart in longitude, and were in most cases along lines of constant declination. The range of galactic latitude of the tracks varied from 9° to 1°.5, for reasons connected with the programming of the survey. The observations were taken on a four-channel statically balanced receiver; one run along a track yielded the variation of intensity as a continuous function of sky position at four fixed frequencies. Records were taken at a sufficient number of discrete frequencies to cover the full frequency range of the line. The results are presented in the form of contour diagrams showing the 21 cm intensity along each track as a function of latitude and radial velocity. In addition, line profiles are given for a series of points around the "new" galactic equator. A combination of this survey and that carried out for the northern sky by the Leiden group gives a coverage of the whole galactic circle at approximately the same resolution. There is good agreement between the two sets of results in the common range of longitude. *Subject Headings:* **1. Radio astronomy surveys 2. Hydrogen lines 3. Radio line emissions 4. Milky way.**—*Authors' abstract.* Ⓢ

11.12–74 523.854:523.164.43

Eriksen, K. W.; Holt, O. and Landmark, B. (*all, Norwegian Defence Res., Estab.*), **A note on the polar absorption event of May 11–18, 1959.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(1):78–81, April **1960.** 2 figs., 2 refs. **DLC**—A strong polar absorption event was observed on Norwegian galactic noise measuring stations in the period May 11–18, 1959. Observations were made at the following five stations: Longyearbyen (78°N, 16°E), Bjornoya (74°N, 19°E), Skibotn near Tromsö (69°N, 20°E), Trondheim (63°N, 10°E) and Kjeller (60°N, 11°E). The method which is used in the recordings is similar to that used in Alaska by LITTLE and LEINBACH (1958), except that no use was made of the frequency sweep technique. The measuring frequency is 28.6 Mc/s, and three-element yagis erected vertically are used. *Subject Headings:* **1. Cosmic radio frequency radiation 2. Galactic radio noise 3. Polar absorption of radio waves.**—*Authors' introduction.* Ⓢ

f. Astronomical Radio Echoes

See also: **Time of registration of meteor reflections** (Peregudov), 11.12–157; **Exploring depth of surface layer of the Moon from radar space observatory** (Fensler et al.), 11.12–180; **Faraday rotation observations of exosphere** (Dyce), 11.12–438.

11.12–75 523.164.8(08)

Leadabrand, Ray L. (*Stanford Res. Inst., Menlo Pk., Calif.*), **Radar Astronomy Symposium report.** *Journal of Geophysical Research*, Wash., D. C., 65(4):1103–1118, April **1960.** 12 figs., 14 refs. **DLC**—The purpose of the Symposium held in San Diego, Oct. 1959, by the U. S. National Committee of the International Scientific Radio Union, was to call attention to the potential usefulness of radar in the exploration of the solar system and to report on past work. The following topics were included: radar studies of the moon; planets; exosphere and the interplanetary medium—sun, meteors and auroras. The members of the panel made a progress report in each field and indicated the potentialities for future research. The radar approach to astronomical studies in the solar system is fundamentally complementary to passive visual and radio astronomy. *Subject Heading:* **1. Radar astronomy symposia.**—*E.Z.S.* Ⓢ

11.12–76 523.164.83

Blevis, B. C. and Chapman, J. H., **Characteristics of the 488 megacycles per second radio signals reflected from the Moon.** *U. S. National Bureau of Standards, Journal of Research, Sec. D*, 64(4):331–334, July/Aug. **1960.** 4 figs., 4 refs. **DWB, DLC** -Radio signals at 488 megacycles per second, received after reflection from the Moon, have been studied using a continuous wave bistatic radar system located near Ottawa, Canada. These experiments were carried out during 1957 and consisted of monitoring the signals received on two

orthogonal dipoles mounted at the focus of a 28 foot parabolic tracing antenna. The total mean received signal yielded an effective radar cross section of the Moon at this frequency of 0.05 of the projected area. The libration fading as observed in the two orthogonal receiver channels was in synchronism, with a cross-correlation coefficient of 0.89. It was established that the signal is not depolarized significantly on reflection at the surface of the Moon or in passing through the ionosphere. Rotation of the plane of polarization of the radio wave in the double passage through the ionosphere was observed to change by nearly 180 degrees over a six-hour period during quiet ionospheric conditions. *Subject Heading:* **1. Radio wave reflection from moon.**—*Authors' abstract.* Ⓢ

11.12–77 523.164.83

Hughes, V. A. (*Royal Radar Estab., Malvern*), **Roughness of the Moon as a radar reflector.** *Nature*, London, 186(4728):873–874, June 11, **1960.** 8 refs. **DWB**—The echo is the result of scattering from a rough surface such that many irregularities contribute. The surface has vertical irregularities which are greater than a wavelength and a horizontal scale which is considerably larger. To determine the order of magnitude for the roughness it was decided to measure more accurately the angular scattering properties and wave lengths of 10 cm, using the 2-MW radar transmitter in the 45 ft diameter radio telescope and a pulse length of 5μ sec corresponding to a range resolution of 0.75 km. The mean of 31 runs shows a very close fit to an exponential law over a range of angles from about 3° to at least 14°. We can say that over representative areas of 8000 km², the slope would appear to have a random distribution with a root mean square value of about 1 in 20. *Subject Headings:* **1. Moon's surface 2. Radar echoes from moon.**—*E.Z.S.* Ⓢ

11.12–78 523.164.85

Kashcheev, B. L. and Lebedinets, V. N. (*both, V. I. Lenin Kharkov Polytechnic Inst.*), **Structure of the quadrantid meteor stream.** *Soviet Astronomy AJ*, New York, 4(1):114–117, July/Aug. **1960.** 5 figs., 5 refs. **DLC.** Transl. of **O strukture meteornogo potoka Kvadrantid.** *Astronomicheskiĭ Zhurnal*, Moscow, 37(1):119–122, Jan./Feb. **1960. DLC**—The results of measurements of the number and duration of meteor radio echoes recorded at Kharkov in Jan., 1959, are used. The distribution of meteors with respect to duration shows that the largest particles are concentrated in the central condensation of the Quadrantid stream. The maximum of the number of particles colliding with the earth occurs later in time, in proportion to the size of the particles considered. The mass distribution of meteoric bodies shows that there is apparently some lower limit to the mass of particles retained in the stream. The same distribution pattern is observed in the case of meteoric particles belonging to the Geminid shower. *Subject Headings:* **1. Meteor mass 2. Radio echoes from meteors.**—*Authors' abstract.* Ⓢ

5. THE SUN

A. General

See also: **Universal sundial** (Egger), 11.12–3; **Spectrograph for solar paramagnetic resonance** (Becherer), 11.12–24; **Model solar systems** (Chamberlain), 11.12–27; **Radio emissions from the Sun** (Section A4c), 11.12–45 to 11.12–62; **Equatorial acceleration of Sun** (Schoenberg), 11.12–166; **Solar component of cosmic radiation** (Section B2g), 11.12–245 to 11.12–254; **Solar photovoltaic power sources for space vehicles** (Sailor), 11.12 475; **Escapes and solar shorts** (Muller), 11.12–518; **Solar probe** (Haviland), 11.12–519.

11.12–79 523.036.51 551.521:551.511.1

Böhm, K. H. and Richter, E., **Der Einfluss des Strahlungsaustausches auf die Konvektion in a polytropic atmosphere.**] *Zeitschrift für Astrophysik*, Berlin, 48(4):231–248, **1959.** 3 figs., 2 tables, 15 refs., 51 eqs. **DLC**—The convective instability of different perturbations in a plane parallel atmosphere with a strong density variation is investigated including the effects of radiation. The variability of the absorption coefficient $\varkappa$ as a function of temperature and density is taken into account. The instability of a disturbance of wavelength λ (expressed as a

fraction of the zone thickness z_0) depends on: the ratio γ of the specific heats; the exponents ν and ι, describing the temperature and density dependence of the opacity and a dimensionless number C, which can be interpreted as the ratio of the time of free fall through the convection zone and the relaxation time for radiation crossing the zone. The eigenvalue problem, determining the "instability" as a function of the wavelength of the perturbation, has been solved numerically for about 50 different cases assuming $\varkappa$ proportional to the gas pressure. In this case the wavelength of maximal instability varies like $C^{9/40}$ in the range covered by our computations. For $C=7.65\times10^{-3}$ the wavelength of maximal instability is slightly smaller than the zone thickness. An application of these calculations to the solar convection zone yields 320 km for the wavelength of maximal instability in the upper part of the zone. *Subject Headings:* **1. Radiation variations 2. Convection 3. Solar convection zone.**—*Author's abstract.* Ⓢ

11.12–80 523.741/6 523.752

Kiepenheuer, K. O. (*Fraunhofer Inst., Freiburg i. Br.*), **Über die Struktur der gestörten Sonnenatmosphäre.** [Structure of the disturbed solar atmosphere.] *Zeitschrift für Astrophysik*, Berlin, 49(2):73–94, **1960.** 10 photos., table, 11 refs., several eqs. English summary, p. 73. **DLC**—The observation of thread-shaped loops in the photosphere is reported (length $\lesssim$8000 km, thickness $\lesssim$1500 km) which preferably occur in the vicinity of spots showing strong changes of their magnetic field. The chromospheric structures in a center of activity are reduced to the following basic elements, which all together form the well known vortex structure: dark elongated structures ($\sim1500\times4000$ km) visible only in the wing of $H\alpha$, probably to be identified with spicules, arranged in the form of hedges; long threads, visible only in $H\alpha$ (length 20,000 to 100,000 km, thickness $\lesssim$1000 km), which connect spots of opposite polarity or a spot with its surrounding or two points outside the spots, the points of intersection always falling on the hedges; some threads in the form of loops; bright dots (diameter in $H\alpha$ $<$1500 km, in K_3 $\lesssim$2500 km); bright regions in $H\alpha$ and K_3 with dimensions $>$5000 km in the very vicinity of spots. The observed photospheric and chromospheric threads and loops are interpreted as flux tubes of the deep seated magnetic field, which have penetrated the photospheric granulation outside the sunspots. *Subject Headings:* **1. Solar disturbances 2. Photosphere 3. Sunspot structure.**—*Author's abstract.* Ⓢ

11.12–81 523.75:538.69:532.59

Plumpton, C. (*Queen Mary College, Univ. of London*), **The propagation of hydromagnetic waves of finite amplitude in a horizontally stratified atmosphere.** *Astrophysical Journal*, Chicago, 129(3):752–757, May **1959.** 4 refs., 35 eqs. **DWB, DLC**—The vertical propagation of a train of transverse harmonic hydromagnetic waves of finite amplitude in the presence of a uniform vertical magnetic field is discussed. It is shown that, although in this case the motion of the gas cannot be wholly horizontal, the vertical motion is negligible so long as the particle velocity is small compared with the local sonic velocity. Approximate solutions of the field equations are derived, and the results are discussed in relation to the propagation of waves in the solar atmosphere. *Subject Headings:* **1. Hydromagnetic wave propagation 2. Solar atmosphere.**—*Author's abstract.* Ⓢ

11.12–82 523.036.51

Pottasch, S. R. (*Boulder Labs., Nat. Bur. Stands.*), **Use of the equation of hydrostatic equilibrium in determining the temperature distribution in the outer solar atmosphere.** *Astrophysical Journal*, Chicago, 131(1):68–74, Jan. **1960.** 2 figs., 2 tables, 15 refs., 7 eqs. **DWB, DLC**—The temperature distribution from 1.0043 (3000 km) to 20 solar radii in the sun's atmosphere is computed from the observed density distribution in this region and the assumption of hydrostatic equilibrium. The temperature distribution shows a maximum between 1.1 and 3 solar radii and a decrease in temperature thereafter. This decrease in temperature is consistent with CHAPMAN's suggestion of thermal conduction only if loss of energy by radiation is included. Inclusion of a radiative energy loss also is shown to invalidate PARKER's argument against hydrostatic equilibrium out to large distances from the sun. *Subject Heading:* **1. Solar temperatures.**—*Author's abstract.* Ⓢ

11.12–83 522.1:523.7(52)

Hatanaka, Takeo, **Issledovaniia Solntsa v Iaponii.** [Solar studies in Japan.] *Priroda*, Moscow, No. 8:77–81, Aug. **1959.** 7 figs. **DLC**—This review of solar studies made in recent years in Japan includes detailed information on investigations of solar activity carried out by optical methods and with the aid of radio waves. The optical observations are made at the Tokyo Astronomical Observatory of Tokyo University, while the radioastronomical studies are performed by both the Tokyo observatory and the Institute of study of Atmospheric Phenomena at Toyokava near Nagoya. Numerous photos and graphs illustrating the text are included. *Subject Headings:* **1. Solar research 2. Tokyo Astronomical Observatory 3. Japan.**—*A.M.P.* Ⓢ

B. Photosphere, Limb, Center Surface, Faculae

See also: **Solar disturbances producing type II radio bursts** (Giovanelli), 11.12-52.

11.12–84 551.507.321.2:522.2:523.741:778.3

Ein Ballon-Teleskop zur Erforschung der Sonnenphotosphäre. [A balloon telescope for exploring the solar photosphere.] *Umschau*, Frankfurt, a.M., 59(21):664, Nov. 1, **1959.** 2 figs. (incl. photo). **DLC**—A photograph and a diagram of the reflecting telescope designed by M. and B. Schwarzschild to photograph the surface of the Sun from very high altitudes in a free balloon are presented and some of the results of studies on the granulation of the Sun are described. The photograph made from balloons indicates that the bright granulation elements are shaped like irregular polygons and that their diameters range between 250 and 1700 km. The dark areas of the granulation consist only of a thin network that surrounds the bright elements. The structure corresponds to a non-stationary convection (as opposed to stationary convection which arises during slighter thickness of the convection zone and produces rather regular polygons of uniform size). Occasionally also round structures arise, the socalled pores, which have a longer life than the bright granules. There are small sunspots stabilized by a magnetic field. The photographs are used to measure the decrease in brightness at the rim of the Sun from which the decline in temperature and density in the outermost layers of the photosphere can be calculated. *Subject Headings:* **1. Balloon-borne telescopes 2. Solar physics 3. Astrophotography 4. Photosphere.**—*I.L.D.* Ⓢ

11.12–85 523.75:535.51 551.593.7

Dollfus, Audouin and Leroy, Jean-Louis, **Polarisation de la lumière au bord du disque solaire.** [Polarization of light at the rim of the solar disk.] *Académie des Sciences, Paris, Comptes Rendus*, 250(4):665–667, Jan. 25, **1960.** 2 figs., 3 refs. **DWB, DLC**—At the Paris-Meudon observatory, using a very sensitive polarimeter, the authors have studied the polarization of light at the edge of the solar disk. The light of the solar photosphere is slightly polarized; the proportion increases from the center to the edge where it reaches a value of some ten-thousandths, and it is larger for shorter wavelengths. The faculae observed close to the edge diminish the polarization while the protuberances increase it slightly by about 1/10,000 which would be ascribable to the diffusion by their free electrons. The diffusion by ions and free electrons of the photosphere and low chromosphere must be considered to account for the observed polarizations. The quantitative study of this phenomenon will lead to an improvement of the theoretical model of the photosphere. *Subject Headings:* **1. Polarization 2. Photosphere 3. Meudon Observatory, Paris.**—*A.V.* Ⓢ

11.12–86 523.741

Voigt, H. H., **"Drei-Strom-Modell" der Sonnenphotosphäre, 2, Die infraroten Nickellinien λ7789 und 7798 Å.** ["Three stream model" of Sun's photosphere, Pt. 2, The infrared nickel lines λ7789 and 7798 Å.] *Zeitschrift für Astrophysik*, Berlin, 47(3):144–160, **1959.** 4 figs., 2 tables, 16 refs., 18 eqs. **DLC**—The center-limb variation of the infrared nickel lines λ7789 and 7798 Å (χ_{ex}=1.9 and 3.4 eV) has been observed with high dispersion (0.2 Å/mm). The line profiles have been calculated by taking into account the inhomogeneities of temperature according to a "three stream model" in a similar way as has formerly been done in the case of the highly excited oxygen lines in the infrared [Voigt 1956]. Damping has been

taken into account. The half widths are insensitive to the temperature inhomogeneities; their center-limb variation yields a microturbulence increasing with the height in the photosphere from very low values to about 2 to 3 km/sec in the upper layers, in accordance with VOIGT. The line 7798 shows a small uncertain asymmetry only in the center of the solar disk; also the theoretical profile is surprisingly symmetrical though the contributions of the single streams are displaced and asymmetrical. The different effects compensate each other completely. Therefore no more information can be obtained in this way. It seems that only lines of high excitation give a noticeable asymmetry. But, as already noted, the observed lines are more "V-shaped" whereas the lines calculated with a normal "one stream model" become more "U-shaped." By using a three stream model this discrepancy becomes smaller but it does not disappear. This seems to be the most important starting point for further studies. The other line 7789 shows a strong asymmetry which is constant over the Sun's disk, in total disagreement with the theoretical calculation. We suppose that an unknown blend is situated on one side of this line. *Subject Heading:* **1. Photosphere.**—*Author's abstract.* Ⓢ

11.12–87 523.742

Bruzek, Anton, **Über die Spiculen auf der Sonnenscheibe.** [Spicules on the solar disk.] *Zeitschrift für Astrophysik*, Berlin, 47(3):191–197, **1959.** 2 figs., 7 refs. **DLC**—The properties of the dark mottles which are seen on Hα-filtergrams of high definition are studied. It is found that there are about 15,000 mottles on the whole (undisturbed) Sun with diameters from 2000 to 5500 km and a mean life time of 10 minutes. Doppler shifts corresponding to velocities up to 50 km/sec are observed. Near the Sun's limb the mottles are stretched up to a length of 8000 to 12,000 km. The results strongly favor the identification of the mottles with the spicules observed at the Sun's limb. *Subject Heading:* **1. Spicules.** —*Author's abstract.* Ⓢ

11.12–88 551.507.321:522.2:523.743.77

Rogerson, John B., Jr. (*Princeton Univ. Observ.*), **The solar limb intensity profile.** *Astrophysical Journal*, Chicago, 130(3):985–990, Nov. **1959.** fig., 2 tables, 7 refs., 2 eqs. **DWB, DLC** —A selected photograph of the solar limb, taken by a balloon-borne telescope, has been analyzed to give the intensity distribution of the solar limb at λ5400 A. This work extends existing limb-darkening measurements to within about 1 second of arc of the limb. *Subject Headings:* **1. Balloon-borne telescopes 2. Solar limb intensity 3. Astrophotography.**—*Author's abstract.* Ⓢ

11.12–89 523.774/5

Herzberg, Luise (*Defence Res. Board, Ottawa*), **The wavelength displacements of some infrared lines between limb and center of the sun, Pt. 2.** *Canadian Journal of Physics*, Ottawa, 38(6):853–865, June **1960.** 4 figs., 14 refs., 5 tables. **DWB, DLC**—The differences between the wavelengths at the solar limb and at the center of the disk have been measured for lines of Fe I, Si I, and Ca II in the λ8500 Å and λ8900 Å regions of the spectrum. The values of the limb-center displacements (in km/sec) of the Fe I lines in the two wavelength regions studied are found to be the same as those obtained by M. G. ADAM for neutral metal lines at λ6100 Å. The limb-center displacements of the Si I lines are similar in magnitude and in the same direction as those of Fe I. Although the data are insufficient to decide the question as to term dependence of the solar wavelength shifts of Si I, any relation to the shifts observed in a laboratory light source can be excluded. For the Ca II lines at λ8500 Å and λ8900 Å, corresponding to two different transitions, the limb-center displacements of the λ8900 Å Ca II lines are smaller than those of the Fe I lines, while those of the λ8500 Å Ca II lines are significantly larger and in direction opposite to those observed for lines of Fe I. Where possible, comparison has been made between the wavelengths observed at limb and center of the disk and the solar wavelengths predicted by General Relativity Theory. In all cases the wavelengths at the limb were found to be closer to the predicted values than the wavelengths measured at the center of the disk. While for the lines of Fe I the predicted solar wavelengths and those observed near the limb ($r/R = 0.982$) are in good agreement, the wavelengths close to the solar limb of the λ8500 Å Ca II lines are found to be significantly larger than those predicted by relativity theory. *Subject Headings:* **1. Solar spectrum 2. Spectral line shift.**—*Author's abstract.* Ⓢ

11.12–90 523.743

Biermann, L.; Kippenhahn, R. et al., **Beiträge zur Theorie der Sonnengranulation.** [Theory of the solar granulation.] *Zeitschrift für Astrophysik*, Berlin, 48(3):172–188, **1959.** 10 figs., 2 tables, 23 refs., numerous eqs. **DLC**—Numerical calculations of several models for the hydrogen convection zone of the sun show that the observed size of the granulae is of the order of the scale height for the layer in which they originate. The propagation of distorsions due to the granulation into the outer layers of the sun is discussed. Especially the case of hydromagnetic waves across a horizontal magnetic field is studied in detail.—*Subject Headings:* **1. Solar granulation. I. Lüst, R. II. Temesváry, St.**—*Authors' abstract.* Ⓢ

11.12–91 523.747:523.753:535.245

Mouradian, Zadig, **Sur la photométrie des facules éruptives associées avec les disparitions brusques des filaments solaires.** [Photometry of eruptive faculae associated with the sudden disappearances of solar filaments.] *Académie des Sciences, Paris, Comptes Rendus*, 250(6):978–980, Feb. 8, **1960.** 2 figs. table, 4 refs. **DWB, DLC**—Study, from a thermometric point of view, of 14 cases of eruptive faculae associated with sudden disappearances of filaments. These sudden disappearances of filaments are sometimes accompanied by bright points in $H\alpha$ on the solar disc. They are called eruptive faculae but commonly reported as eruptions. The curves of light obtained can be divided into two distinct categories: some are "flat," presenting only irregular fluctuations, while the others are similar to those of common eruptions. Characteristics of these two light curves and their relations with sun-spots are given. It seems that the eruptive faculae associated with sudden disappearances of filaments are generally quite distinct from genuine eruptions by the amplitude and aspect of their curve of light. Only when the phenomenon happens in close vicinity to a group of spots, i.e. near to high magnetic fields, does it display the behavior of a typical eruption. Never have ionospheric disturbances associated with eruptive faculae been observed. *Subject Headings:* **1. Solar flares 2. Solar filaments 3. Magnetic field of sunspots 4. Sunspot photometry 5. Meudon Observatory, Paris.**—*A. V.* Ⓢ

c. Sunspots

See also: **Indices of solar activity during IGY** (Bazzard), 11.12-45; **Variations in solar radiation at 200 Mc/s** (Hauge), 11.12–54; **Correlation between umbra of sunspots and radiation on 200 Mc/s** (Maltby), 11.12–55; **Relation between eruptions and sunspot fields** (Bruzek), 11.12–98; **Form and area of monochromatic corona** (Waldmeier), 11.12–117; **Soft radiation measurements on Explorer VI** (Rosen et al.), 11.12–283; **Geomagnetic disturbances and relative sunspot number** (Mitropol'skaia), 11.12–313; **Region-E and solar activity** (Beynon, Brown), 11.12–380; **Ionization in F2 layer** (Minnis, Bazzard), 11.12–402; **Index of solar activity based on F2 layer** (Minnis, Bazzard), 11.12–403.

11.12–92 551.593.7:523.746

Babcock, Horace W. (*Mt. Wilson and Palomar Obs.*), **Test for polarization in the integrated light of sunspots.** *Astronomical Society of the Pacific, San Francisco, Publications*, 72(426):204–205, June **1960.** 3 refs. **DLC**—A test of the integrated light of sunspots and surrounding faculae, for the purpose of detecting circular or plane polarization is reported. The test was carried out with a 150-foot tower telescope on Mt. Wilson on January 29, 1960. The observations were made photoelectrically by converting the solar magnetograph to a photometer. The results showed no indications of polarization. *Subject Headings:* **1. Polarization 2. Sunspots.**—*I.S.* Ⓢ

11.12–93 523.746

Becker, U., **Über eine sekundäre Fleckenzone.** [On a secondary spot area.] *Zeitschrift für Astrophysik*, Berlin, 48(2):88–94, **1959.** 4 figs., table, 5 refs. **DLC**—A butterfly diagram of sunspots for the years 1879–1950 is presented giving lines of equal spot areas. In addition to the main equatorial zones, high latitude zones of spot activity are found. The connection between these zones and the polar zones of prominence activity is discussed. *Subject Heading:* **1. Sunspot activity.**—*Author's abstract.* Ⓢ

11.12–94 523.746

Cragg, Thomas A. (*Mt. Wilson and Palomar Obs.*), **Solar activity in 1959.** *Astronomical Society of the Pacific, San Francisco, Publications*, 72(426):200–203, June **1960.** fig., 3 tables. **DLC**—The observations of the Sun made at Mt. Wilson during 1959 are reported and tabulated. Observations were made on 339 days. The total number of sunspot groups observed in 1959 was 818, the third highest on record at Mt. Wilson. Tabulated are the sunspot groups observed during 1959, the monthly means of the groups observed per day for the last three years, and the largest sunspot groups of 1959. *Subject Headings:* **1. Solar activity 2. Sunspot data.** —*I.S.* Ⓢ

11.12–95 523.74/5

Müller, R., **Die Sonnentätigkeit im ersten Halbjahr 1959.** [Solar activity during the first semester 1959.] *Die Sterne*, Leipzig, 36(1/2):14–16, Jan./Feb. **1960. DLC**—This article shows that after the sunspot maximum at the end of 1957 and beginning of 1958, formation of active spots has been observed. The relative numbers for February and June 1959 have been $R=90$–190, January and May showed a high value: $R=260$–280. The first six months of 1959 had a total of 11 days with spotless southern hemisphere. A table shows eruptions observed during the sunspot maximum and a graph gives the evolution of the intensity of the monochromatic solar corona. *Subject Headings:* **1. Solar activity 2. Solar eruptions 3. Solar coronal monochromatic intensity.**—*A.V.* Ⓢ

11.12–96 523.74/77:551.510.53

Servajean, Roger, **Etude du champ des vitesses Evershed dans une tache solaire.** [Study relating to the field of Evershed speeds in a sunspot.] *Académie des Sciences, Paris, Comptes Rendus*, 248(14):2071–2073, April 6, **1959.** 1 fig., 4 refs. **DWB, DLC**—By means of measurements made on spectrograms recorded at Meudon, one determines the variation of the components of Evershed speed in penumbra and near photosphere. Description of the method and observation outfit, analysis of the measurements and statement of the results. One notes a downright center-edge effect. The radial horizontal component of Evershed speed III varies apparently, according to the distance of the spot to the center of the sun; it increases regularly from the umbra onwards, presents a maximum between four and five sixths of the penumbra width, and then decreases. *Subject Headings:* **1. Sunspots 2. Photosphere 3. Evershed speed 4. Meudon, France.**—*A.V.* Ⓢ

11.12–97 523.746:521.27

Xanthakis, Jean (*Athens Academy, Greece*), **L'expression de l'activité solaire en fonction du temps d'ascension.** [Solar activity expressed as a function of the time of rise.] *Annales d'Astrophysique*, Paris, 22(6):855–876, **1959.** 9 figs., 12 tables, 7 refs. French, English and Russian summaries p. 855–856. **DWB, DLC** -In the first part of this work, the author establishes analytically the maximum of the solar activity (areas of sunspots, umbrae, faculae, and WOLF numbers) as a function of the time of rise. The latter is expressed in solar synodic rotations or in months. The author also shows that the maxima of the solar activity (areas and WOLF numbers) as well as their mean values per cycle obey a parabolic law. In certain cases the deviations from this law seem not to be fortuitous, but are periodic functions of a long period. In the second part, the author studies the mean daily areas of sunspots for each year 1879–1953 and also the WOLF numbers 1755–1953. In this case the analytical representation of the curves of the solar activity is given as a function of the time of rise expressed in years. The author next examines: a) The distribution of the secondary maxima and minima of the solar activity as a function of the time of rise. This distribution does not seem fortuitous when we consider the cycles by groups with the same time of rise. b) The ratio $N/(N+S)$, where N and S represent the total areas of the spots for each cycle in the northern and the southern part of the solar equator respectively, seems to depend on the time of rise. c) The asymmetry N/S of the two hemispheres can be expressed as a function of the time of rise and of one periodic term the period of which is 7 solar cycles. *Subject Headings:* **1. Solar activity 2. Sunspot relative numbers 3. Solar activity-time of rise relationships.**—*Author's abstract.* Ⓢ

D. Flares

See also: **Radio emission associated with flares** (Boischot et al.; Feiter et al.; de Jager), 11.12–46 to 11.12–48; **Solar component of cosmic radiation** (Section B2g), 11.12–245 to 11.12–254; **Ionospheric effects associated with solar flare** (Harrison), 11.12–429.

11.12–98 523.75:523.746

Bruzek, A. (*Fraunhofer Inst., Freiburg i. Br.*), **Beobachtungen über die Beziehungen zwischen Eruptionen und Fleckenfeldern.** [Observations on the relation between eruptions and sunspot fields.] *Zeitschrift für Astrophysik*, Berlin, 50(2):110–120, **1960.** 4 figs., 12 refs. English summary p. 110. **DLC**—Within one large spot group there developed three great flares on June 16, 17 and 18, 1959, and three 3+ flares on July 10, 14 and 16. The relations between the development of these flares and the spot and its magnetic field were studied. It was found that: 1) the great flares appeared during periods of slowly and continuously proceeding important changes in spot and magnetic field structure. No connection could be found between any special phase of spot development and onset of great flares. 2) In spite of considerable changes in the spot structure all the flares originated at the same position relative to the spot umbrae and had almost the same shape. 3) The great flares and most of the minor ones originated at the edges of umbrae and near or on the "neutral line" of zero longitudinal magnetic field strength. This means that the flares originated in regions of strong magnetic fields frequently with a strong or even predominant transverse component—but never in "neutral points" of zero field strength. *Subject Headings:* **1. Solar flare-sunspot relationships 2. Sunspot structure.**—*Author's abstract.* Ⓢ

11.12–99 523.75:550.385:551.507.362.2

Fan, C. Y.; Meyer, P. and Simpson, J. A. (*all, Univ. Chicago*), **Preliminary results from the space probe Pioneer V.** *Journal of Geophysical Research*, Wash., D. C., 65(6):1862–1863, June **1960.** 2 figs., 2 refs. **DLC**—Solar flare particles producing ionization in the polar atmosphere for many hours are not stores in the geomagnetic field. Evidence has been found for the solar production of energetic electrons by processes other than solar flares. Bremsstrahlung was measured in Pioneer V. *Subject Headings:* **1. Solar emission models 2. Ionization processes 3. U. S. Satellite 1960 Alpha (Pioneer V).**—*E.Z.S.* Ⓢ

11.12–100 551.507.362.1:523.75

Friedman, Herbert; Chubb, Talbot A. and Kreplin, Robert W. (*all, U. S. Naval Res. Lab.*), **Sunflare II: rocket observations of solar activity.** *American Geophysical Union Transactions*, 41(1):95–98, March **1960.** fig. **DWB, DLC**—The U. S. Naval Research Laboratory launched the sunflare II series, 12 Nike-Asp rockets from Point Arguello on the Pacific Missile Range between July 14 and Sept. 1, 1959. Eight launchings were completely successful, reaching heights between 130 and 150 miles. Three of the eight rockets were lauched during flares and the others when the sun was quiet or only mildly active. The present paper systematically discusses the data obtained from these launchings and lists the conclusions. A graphical representation of the sunflare experiment illustrates the study. *Subject Headings:* **1. Rocket solar observations 2. Solar flare observations from rockets.**—*I.S.* Ⓢ

11.12–101 523.75

Hansen, Richard and Gordon, Diane (*both, High Altitude Obs., Univ. of Colorado*), **The limb flares of October 13, 1958.** *Astronomical Society of the Pacific, San Francisco, Publications*, 72(426):194–199, June **1960.** 3 figs., table, 2 plates, 9 refs. **DLC**—This paper discusses and graphically illustrates five solar events observed on a single day on Oct. 13, 1958. These events were observed above the limb of the Sun, thus giving information on flare development from the profile view. The observation showed that the general shape of the magnetic field above an active region is unaltered by flare events, or the magnetic field was restored to its pre-flare configuration in the course of the 2 to 3 hours between the events. *Subject Headings:* **1. Solar flares.**—*I.S.* Ⓢ

11.12–102 523.75:551.521.64

Křivský, L.; Hladký, J.; Mokrý, P. et al., **Solar flare connected with an increase of intensity of cosmic rays.** *Il Nuovo Cimento*, Bologna, Ser. 10, 15(4):695–696, Feb. 16, 1960

DLC—A brief note that on October 6, 1959 from 14.09 till 14.45 GMT a chromospheric flare of medium importance 1 was recorded at the Astronomical Observatory Ondřejov near Prague. Its position was 30.5°N 63°E. It was accompanied by an active filament of the "surge" type. An increase of cosmic ray intensity was recorded at the cosmic ray observatory Lomnický Štít (2634m) and Prague-Karlov (228m) which are equipped with standard neutron monitors and cubical telescopes. It lasted about 25 min about (50—70) min after the maximum of brightness of the flare and of the maximum development of the "surge." The increase began nearly simultaneously at all detectors and seems to be far above the statistical fluctuations at least at the mountain observatory. Because of the rather small importance of the solar flare the observed increase of cosmic ray intensity in the diffuse impact zone is unexpectedly large. We are inclined to suppose a correlation of the observed increase with rapid changes of the magnetic field during the development of the solar flare and filament. *Subject Headings:* **1. Magnetic effects on cosmic rays 2. Solar flare effects on cosmic rays 3. Cosmic ray increases. I. Chaloupka, P. II. Kowalski, T.**—*E.Z.S.* Ⓢ

11.12–103 523.75 523.77

Michard, Raymond, (*Paris-Meudon Observatory*), **Spectroscopie des éruptions solaires dans le programme français de l'A.G.I., II, Généralités sur les spectres des éruptions.** [Spectroscopy of solar eruptions in the French program of the I.G.Y., Pt. 2, Generalities on the eruption spectra.] *Annales d'Astrophysique*, Paris, 22(6):887–900, **1959.** 3 figs., 2 plates, 3 tables, 14 refs. French, English and Russian summaries p. 887. **DWB, DLC** –Some 200 spectra (λ8800–3600) of 60 different flares have been examined qualitatively; estimates have been made of the intensities of important lines and of the continuum when present. Spectral variations with phase and with location on the disk of the flare phenomena were found statistically. Metallic lines emission comes from deeper layers than hydrogen lines emission, and decreases generally faster after the maximum. The continuum is confined to the earlier phase of the flare; its spectral distribution ("violet" color) and center-limb variation are similar to those of faculae. Our observations suggest that flares seen outside the limb generally pertain to a later phase in the flare process than the "flash" (in ELLISON's sense) of disk flares; their emission comes from higher layers and has different characteristics. *Subject Headings:* **1. Solar eruptions 2. Solar flares 3. Solar spectrum.**—*Author's abstract.* Ⓢ

11.12–104 523.75:550.385.26

Veldkamp, J. and van Sabben, D. (*both, R. Netherlands Met. Inst., De Bilt*), **On the current system of solar-flare effects.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(2/3): 192–202, June **1960.** 7 figs., 16 refs., 6 eqs. **DLC**—The electric current system responsible for the great solar flare effect (s.f.e.) of March 23, 1958, is compared with the currents of the normal daily variation of the geomagnetic field. Whereas the standard S_q-currents are symmetric with respect to the geographic equator, the pattern of the currents of the s.f.e. as well as that of the currents of the normal daily variation at the time of the s.f.e. are controlled by the magnetic equator. The same result is found by a re-examination of selected s.f.e.s published in the IATME Bulletins nos. 12f and 12h. It is shown that the s.f.e. currents must flow in a region where the disappearance of electrons follows an attachment law. The decrease of the s.f.e. leads to a loss coefficient $\beta = 5 \times 10^{-4}$ sec^{-1}, which compares with the known value for the D layer. *Subject Headings:* **1. Solar flare effects on geomagnetism 2. Diurnal geomagnetic variations.**—*Authors' abstract.* Ⓢ

E. Chromosphere, Prominences

See also: **Structure of type IV jumps** (Pick-Gutmann), **11.12–56.**

11.12–105 523.752

Becker, U., **Die Beobachtung von Surges, Filamenten und chromosphärischen Strukturen im Integrallicht.** [Observation of surges, filaments and chromospheric structures in white light.] *Zeitschrift für Astrophysik*, Berlin, 48(3):189–202, **1959.** 12 figs., table, 13 refs. **DLC**—Observations in white light of surges and of different types of filaments are described.

The contrast against the undisturbed photosphere was never more than a few percent. The observed markings were colorless and blurred. Their visibility does not seem to change from center to limb. The effect is likely to be caused by the scattering of free electrons. *Subject Heading:* **1. Chromosphere.**—*Author's abstract.* Ⓢ

11.12–106 523.752 523.7

Michard, Raymond (*Observatoire de Paris-Meudon*), **La raie Hα dans la chromosphère** [The chromospheric Hα line.] *Annales d'Astrophysique*, Paris, 22(5):547–570, Sept./Oct. **1959.** 8 figs., 2 tables, 18 refs., 10 eqs. French, English and Russian summaries. **DWB DLC**—New observations of the chromospheric *Hα* line have been made with the 9 m solar spectrograph in Meudon. A height sequence of spectra, with an image every 730 km, has been analyzed; profiles of the line on-and outside spicules have been compared as a function of height. Above 5–6000 km the *Hα* line on spicules has a pure Doppler profile with a mean width (at half intensity points) of 1.2 Å, the range being of 0.8 to 1.8 Å for different spicules. Under 5000 km this profile is more and more affected by a central absorption (simulating self absorption) which very rapidly increases to strong self reversal. This means that under 5000 km spicules are embedded in a gas strongly absorbing *Hα*, with an absorption profile narrower than that of spicules, and reemitting this line with a smaller source function. The quantitative interpretation of the profiles of both isolated spicules and the chromosphere as a whole, has led to a determination of the *Hα* source function, optical depth and abundance of spicules down to 1000 km and also of the source function of interspicular material. But the absorbing properties of this material could be found only to a very rough approximation. *Subject Headings:* **1. Chromosphere 2. Hα line 3. Spicules 4. Doppler effect of spicules.**—*Author's abstract.* Ⓢ

11.12–107 523.752

Waldmeier, M. (*Eidgen. Sternwarte, Zürich*), **Die Struktur der aktiven Chromosphäre** [Structure of the active chromosphere.] *Zeitschrift für Astrophysik*, Berlin, 50(4):225–232. **1960.** 3 figs., tables, 4 refs. English summary p. 225. **DLC**—The structures in active chromospheric regions, the so-called mushrooms, show an average height of 11,000 km and a diameter of 2000–3000 km. Their mean lifetime is 10 minutes and their mean ascending velocity amounts to 25 km/sec. They are bigger than the structures of the undisturbed chromosphere, the so-called spicules, but smaller than the surges. On the solar disk they appear as bright points or as microflares. *Subject Headings:* **1. Chromosphere 2. Solar flares.**—*Author's abstract.* Ⓢ

11.12–108 523.74/5

Karimov, M. G. and Shilova, N. S., **O vzaimosviazi dvizheniia materii korony i protuberantsev.** [On the relationship between the motion of coronal matter and that of prominences.] *Akademiia Nauk Kazakhskoĭ SSR. Astrofizicheskiĭ Institut, Izvestiia*, 9:10–20. **1959.** 5 figs., 4 tables, 14 refs., numerous equations. English summary p. 20. **DLC**—The authors determined the rates of doppler motions within prominences and the corona. The directions and values of these rates were compared with each other, and also with the active part of the photosphere in the investigated section of the chromosphere and corona. Correlation of rates of the corona and prominences are explained from the point of view of electromagnetic mechanism of the motions. *Subject Headings:* **1. Corona activity 2. Solar prominences.**—*Authors' abstract.* Ⓢ

11.12–109 523.75

Obashev, S. O., **Ob elektromagnitnom mekhanizme progreva solnechnykh protuberantsev** [Electromagnetic mechanism of heat production in solar prominences.] *Akademiia Nauk Kazakhskoĭ SSR. Astrofizicheskiĭ Institut, Izvestiia*, 8:64–67, **1959.** 7 refs., 13 eqs. English summary p. 67. **DLC**—The possibility of warming up of solar prominences by an electromagnetic field is considered. It is found that energy variations in solar prominences are a result of the presence of magnetic fields of different intensities in the solar prominence. *Subject Heading:* **1. Solar prominences.**—*Author's abstract.* Ⓢ

11.12–110 523.752:523.038

Obashev, S. O. (*Acad. Scien., KazSSR*), **An electromagnetic mechanism of solar-prominence heating.** *Soviet Astronomy AJ*, New York, 3(6):951–954, May/June **1960.** 8 refs., 9 eqs. Transl. of **Elektromagnitnyĭ mekhanizm progreva solnechnykh protuberantsev.** *Astronomicheskiĭ Zhurnal*, Moscow, 36(6):1037–1040, Nov./Dec. **1959. DLC**—An electromagnetic mechanism of heating of solar prominences is considered. It is shown that the division of prominences into quiescent and eruptive ones results from the presence of magnetic fields of different strengths. The magnetic-field strength of eruptive prominences is larger than that of quiescent prominences. A formula for the lifetime of a prominence has been derived. The lifetime is proportional to the size, and decreases with increasing field strength. The field strength of a prominence has been estimated from the lifetime, and this estimate coincides with that obtained from its motion. *Subject Heading:* **1. Solar prominences.**—*Author's abstract.* Ⓢ

F. Corona

See also: **Optical and radio phenomena associated with a solar activity center** (de Jager), 11.12–48; **Radio emission from outer corona** (Erickson), 11.12–50; **Location of sources of solar bursts** (Shain, Higgins), 11.12–58; **Radioheliograms and coronal intensity** (Waldmeier), 11.12–61; **Solar disturbances responsible for radio bursts** (Wild, Sheridan), 11.12–62; **Relationship between motion of coronal matter and prominences** (Karimov, Shilova), 11.12–108; **Extension of solar corona into interplanetary space** (Parker), 11.12–169.

11.12–111 523.755:551.590.21:621.396

Dollfus, Audouin, **Quelques propriétés des jets de la couronne solaire, observées en lumière blanche.** [Some properties of the white light jets of the solar corona.] *Académie des Sciences, Paris, Comptes Rendus*, 249(25):2722–2724, Dec. 21, **1959.** 3 figs., 4 refs. **DWB, DLC**—The large white light jets of the corona can persist for several months over the active centers of the chromosphere and of certain prominences. They are observed up to the vicinity of the pole, and they coincide generally with the centimetric radioelectric emissions. The jets of the white corona seems to coincide with the regions emitting the 3 cm radiation without interruption. These radioelectric emissions originate probably in the high chromosphere, principally above the spots. *Subject Headings:* **1. Sun's corona 2. Coronal jets-radioelectric emission relationships.**—*A.V.* Ⓢ

11.12–112 523.755:535.33

Karimov, M. G., **Zheltaia koronal'naia liniia 5694A po vnezatmennym nabliudeniiam.** [The yellow coronal line 5694 Å according to observations without darkening.] *Akademiia Nauk Kazakhskoĭ SSR. Astrofizicheskiĭ Institut, Izvestiia*, 8:59 63, **1959.** Fig., 2 tables, 9 refs., eqs. English summary p. 63. **DLC**—Investigating the conditions under which the emission of the yellow coronal line 5694 Å takes place, it was found that the mechanism of the excitement of line 5694 Å is an electron shock. *Subject Heading:* **1. Coronal emission lines.**—*Author's abstract.* Ⓢ

11.12–113 551.521.64 523.755:523.165

Kazachevskaia, T. V. and Ivanov-Kholodnyĭ, G. S. (*both, Acad. Scien., U.S.S.R.*), **Continuous solar emission in the X-ray region.** *Soviet Astronomy AJ*, New York, 3(6):937–942, May/June **1960.** fig., 3 tables, 17 refs., 6 eqs. Transl. of **O nepreryvnom izluchenii solntsa v rentgenovskoĭ oblasti spektra.** *Astronomicheskiĭ Zhurnal*, Moscow, 36(6):1022–1027, Nov./Dec. **1959. DLC**—The Gaunt factor was computed, and the continuous-emission spectrum of the solar corona calculated. $T \simeq 1.5 \cdot 10^6$ *K* was found from x-ray emission, and also from the ratio of x-ray and radio emission. At the earth's surface, the energy of solar continuous emission beyond the Lyman limit is >0.3 ergs/cm^2·sec. It is shown that the solar corona is extremely nonuniform; matter in it is mainly concentrated in regions which occupy 0.01 of the total volume. *Subject Headings:* **1. Coronal emission rays 2. Solar X-radiation.**—*Authors' abstract.* Ⓢ

11.12–114 523.755

Kiepenheuer, K. O., **Über die Verdichtung der Koronamaterie.** [Thickening of the coronal material.] *Zeitschrift für Astrophysik*, Berlin, 48(4):290–297, **1959.** 6 eqs. **DLC** (QB1 Z4)—Because of very efficient radiative cooling the gas pressure of coronal matter when compressed will not increase. Thus an external pressure will bring coronal matter rapidly to the density and temperature of a prominence. Within a center of activity the required pressure will be supplied from the colliding or forming magnetic fields, which in addition are needed to protect the cooled volume initially against the bombardment of coronal ions. The results obtained are applied to explain the formation of flare surges. *Subject Headings:* **1. Corona structure 2. Solar flares.**—*Author's abstract.* Ⓢ

11.12–115 523.755:523.746

Trellis, Michel (*Pic-du-Midi Observatory*), **L'évolution lente des jets coronaux.** [The slow evolution of coronal jets.] *Annales d'Astrophysique*, Paris, 22(6):845 854, **1959.** 6 figs., 2 refs. French, English and Russian summaries p. 845. **DWB, DLC**—Isophote maps of the corona plotted from observations made in the green coronal line show that the lifetime of a "coronal jet" is proportional to its maximum intensity and permit the plotting of the light curve of its slowly variable component. From this the number of "coronal jets" having reached a given intensity may be calculated for different phases of the 11-yr cycle, giving a sensitive index of solar activity. *Subject Headings:* **1. Sun's corona 2. Coronal emission intensities 3. Coronal indexes 4. Solar activity 5. Sunspot cycles.**—*Author's abstract.* Ⓢ

11.12–116 523.755

Trellis, Michel, **Dissymétrie Est-Ouest des intensités de la couronne monochromatique.** [East-west asymmetry in the intensities of the monochromatic corona.] *Académie des Sciences, Paris, Comptes Rendus*, 250(1):58–60, Jan. 4, **1960.** 4 figs., ref. **DWB, DLC**—The intensity measurements of the 5303 Å line of the solar corona, made at the Pic du Midi Observatory show a well marked asymmetry between the eastern and western edges of the sun. This east-west asymmetry presents a systematic annual variation and one is inclined to draw a parallel between this one year periodicity and the position of the earth in its orbit. When assuming that the drift of interstellar material influences the excitation of the corona, one can ask oneself whether the motion of the sun toward the apex provokes an asymmetry in the distribution of this external energy, which might have repercussions on the intensity of the emission lines. Under these circumstances it can be said that one records on an average increasing intensity for the green line and decreasing intensity for the red line in the region of the sun facing the apex. One also observes an asymmetry in the distribution of the active regions between the northern and southern hemispheres respectively but this is an irregular one. *Subject Headings:* **1. Solar coronal green/red ratio 2. 5303 Å line intensity 3. East-west asymmetry of external solar energy 4. Pic du Midi, France.**—*A. V.* Ⓢ

11.12–117 523.755:523.746

Waldmeier, M. (*Sternwarte, Zürich*), **Form und Ausdehnung der monochromatischen Korona.** [Form and area of the monochromatic corona.] *Zeitschrift für Astrophysik*, Berlin, 50(1):35–47, **1960.** 6 figs., 6 tables, 4 refs., English summary p. 35. **DLC**—The present paper deals with the results of more than 12,000 height measurements of the corona from 1939 to 1959. The height of the corona measured in the light of the line 5303 Å varies according to the frequency of sunspots, increasing from 0.5′ during sunspot minimum up to 3.4′ during spot maximum. This variation occurs not only in the spot zone, but also in higher latitudes and even at the pole. The greatest coronal heights are measured over the zones of spots and faculae and amount to up to 1.4′ during spot-minimum and up to 4.8′ during the maximum. The lowest coronal height is observed over the pole, where it is 0.0′ during the minimum and 1.9′ during the maximum. At the equator the coronal heights change from 0.2′ to 4.6′, and there the maximum value is reached about two years after the spot-maximum. Likewise the ellipticity of the coronal isophotes shows its maximum but two years after sunspot maximum. This is due to the fact that the polar corona disappears after the spot-maximum, whereas the maximum extension of the equatorial corona is retained for about two more years. The

variations of the monochromatic corona are remarkably more pronounced than those of the K-component of the white corona regarding their structure as well as their extension. *Subject Heading:* **1. Corona height.**—*Author's abstract.* Ⓢ

G. Eclipses

See also: **F region during solar eclipse** (Datta et al.), 11.12–392; **Photochemical rates in equatorial F2 from 1958 eclipse** (Van Zandt et al.), 11.12–408.

11.12–118 523.78:526.1 523.78:016

†Cameron, Robert C., **Comments on the ephemerides and constants for a solar eclipse (with an eclipse bibliography appended).** Rev. by Edward R. Dyer. *U. S. Air Force. Cambridge Research Center, GRD Research Notes*, No. 11, May **1959.** 67 p. fig., 3 tables, eqs. **DWB**—Corrections to the spheroidal coordinates of a site on the earth's surface or to the geodetic distance between two sites that have been deduced by comparing the observed circumstances of an eclipse with their predicted values are uncertain by an amount that depends on: (1) the uncertainties in the geodetic and astronomical constants, (2) the errors in the ephemerides used in the eclipse calculations, (3) the errors of timing the contacts, and (4) the errors that arise in referring the points of contact to an ideal spherical moon. The effect of these various sources of error on the final result (site coordinates or geodetic distances) is discussed. Ways of minimizing these effects are outlined: for example, certain known errors may be reduced, such as the error of inferring the moon's center from a portion of the limb, which may be nearly eliminated by applying Watts' limb corrections; certain unknown errors may be made to cancel out almost by a suitable choice of sites. The best accuracy in the geodetic distance between two sites that is currently attainable under optimum conditions appears to be about ±70 meters (p.e.), that for absolute site coordinates somewhat worse. This comes about chiefly from residual uncertainties in the values of the earth's radius and the lunar parallax, and in the determination of contact times. It is expected, however, that programs now in progress or projected for the near future, some of which are mentioned, will greatly improve these results. In compiling this report the author consulted the extensive literature on the subject; the appended bibliography grew out of these efforts. *Subject Headings:* **1. Eclipse phenomena 2. Eclipse bibliographies. I. Dyer, Edward R. (ed.).**—*Author's abstract.* Ⓢ

11.12–119 523.78

de Saussure, M. (*Univ. of Geneva, Switzerland*), **Next winter: a total solar eclipse.** *Sky and Telescope*, N. Y., 20(1):16–18, July **1960.** Photos. **DWB, DLC**—A predated announcement and description of the February 15, 1960 total eclipse of the sun. The track of totality is predicted to begin in the Bay of Biscay, passing through Southern France and across Italy, the Balkan countries, and the Black Sea, then crossing a vast stretch of southern and eastern Russia, to be finished in northern Siberia. A map of southern Europe is given showing the track of totality except for its eastern part. *Subject Heading:* **1. Solar eclipse prediction.** —*I.S.* Ⓢ

11.12–120 551.507.362.1:523.78

Instant rocketry. *Astronautics*, N. Y., 4(1):28–29, 82–85, Jan. **1959. DLC**—Describes an operation when Sun eclipsed on Oct. 12, 1958, which was studied with the aid of rockets. The operation took place in the Pacific with American, British and Japanese scientists. It has contributed to our knowledge of the solar spectrum by revealing powerful fluxes of X-rays and extreme ultraviolet light. The rockets were specially equipped with X-ray measurement equipment. The totality rockets were launched at an azimuthal angle of 295° so that entry into eclipse shadow came at an altitude of 120 miles. The results obtained were satisfactory. *Subject Headings:* **1. Rocket astronomy 2. Solar eclipse observations with rockets.**—*E.Z.S.* Ⓢ

11.12–121 523.78

Schadee, A., **De expeditie van de Nederlandse Eclips-Commissie kon enkele waarnemingen bemachtigen.** [Netherlands Eclipse Commission Expedition obtained some observa-

tions.] *Hemel en Dampkring*, The Hague, 57(12):282–286, Dec. **1959.** 3 photos. **DWB, DLC**—Review of photos and measurements taken during the total solar eclipse of Oct. 2, 1959 by the Netherlands Eclipse Commission at Gran Tarajal on the Canary island Fuerteventura. Some information is given on the instruments used. Changes in the brightness of the decreasing solar crescent were measured electronically. The light of the whole crescent was measured on 4 wavelengths: 4280 Å, 4780 Å, 5500 Å and 6160 Å. Photos of prominences were taken with 2 cameras respectively recording the H_β line (4863 Å) and a region near 6200 Å, the latter region being suitable for measuring the very weak continuous light emitted by a prominence. Spectrographs were used to obtain data on the H and K lines of once ionized calcium and on the H_Δ line, all these lines appearing at 3900 Å. Photos of the chromosphere spectrum were taken in the region between 3300 and 4000 Å to study the different behavior of hydrogen radiation and the radiation of metals. Photos are shown of the corona, the chromosphere and prominences, but results of the various measurements and photos taken are not given. *Subject Headings:* **1. Solar eclipse, Oct. 1959 2. Netherlands Eclipse Commission 3. Canary Islands.**—*A. V.* Ⓢ

11.12–122 523.78

Malsch, W., **Die Totale Sonnenfinsternis von 2 Oktober 1959 auf den Kanarischen Inseln.** [The total solar eclipse of October 2, 1959 in the Canary Islands.] *Die Sterne*, Leipzig, 36(1/2):16–18, Jan./Feb. **1960. DLC** –An article giving a description of the observation site and a complete report of the evolution of the phenomenon with indications of meteorological observations. *Subject Headings:* **1. Solar eclipse, Oct. 1959 2. Canary Islands.**—*A. V.* Ⓢ

11.12–123 523.78:551.506.5(468.5)

Meier, L., **Sonnenfinsternisexpedition der Vereinigung der Sternfreunde nach den Kanarischen Inseln.** [Solar eclipse expedition of the Association of Amateur Astronomers to the Canary Islands.] *Die Sterne*, Leipzig, 36(5/6):117–121, May/June **1960.** 3 figs., table. **DLC**—Report of the expedition, on Oct. 2, 1959 of a group of 27 amateur astronomers under the direction of E. MÄDLOW. The author describes the installation and the site of observation. The program consisted in collecting photographs of the solar corona and the purpose was also to get more information on the properties of interplanetary matter. The instrument, a V. E. B. C. Zeiss Jena camera, is described. *Subject Headings:* **1. Eclipse expedition, Oct. 1959 2. Solar corona photographs 3. Canary Islands.**—*A. V.* Ⓢ

11.12–124 551.590.24

Stewart, John W. (*Univ. Virginia*), **Atmospheric phenomena at a sunrise total solar eclipse.** *Weatherwise*, Boston, 13(3):115–117, June **1960.** 2 figs. **DWB**—In addition to the spectacle of the eclipse and the solar corona, the phenomena included: dawn reversal, asymmetry of illumination before and after totality, red tunnel, and the appearance of the moon's shadow in the sky. *Subject Headings:* **1. Solar eclipse effects on meteorological elements 2. Solar eclipses.**—*E.Z.S.* Ⓢ

11.12–125 550.377:550.385:551.590.24

Yamaguchi, Y.; Banno, N.; Oshima, H. and Araki, T., **Effect of the solar eclipse, April 19, 1958 on the geomagnetic field and earth current.** *Kakioka, Japan. Magnetic Observatory, Memoirs*, 9(1):33–40, March **1959.** 6 figs., table, 5 refs., 3 eqs. Japanese summary, p. 33. Also in *Japan. Science Council. Ionosphere Research Committee, Report of Ionosphere Research in Japan*, 12(2):182–187, June **1958.** 5 figs., table, 3 refs., 3 eqs. **DWB**—On the basis of the observations of the geomagnetism and earth-current potential at Kakioka, Memambetsu and Kanoya, the effect of the solar eclipse on April 19, 1958 on them (mainly on solar diurnal variation on calm days) are examined. Owing to the magnetic conditions, conclusive results cannot be obtained but the observed effects fairly coincide with the calculated values. In the case of the solar eclipse, a temporary night appears. Otherwise, it is said that the occurrence and magnitude of the variations of the terrestrial magnetic field, such as pulsations, bays, etc., depend on the local time. It may be possible, therefore, that they are affected by temporary night in case of the solar eclipse. *Subject Heading:* **1. Eclipse effects on geomagnetic field.**—*Authors' conclusion.* Ⓢ

H. Solar-Terrestrial Relationships

See also: **Solar radio emission and ionospheric D layer** (Hachenberg, Volland), 11.12–53; **Results of space probe Pioneer V** (Fan et al.), 11.12–99; **Extension of solar corona into interplanetary space** (Parker), 11.12–169; **Theory of polar geomagnetic storms** (Piddington), 11.12–308; **Ionospheric effects associated with solar flare** (Harrison), 11.12–429; **Solar effects on acceleration of artificial satellites** (Jacchia), 11.12–550; **Solar activity and deceleration of satellites** (Priester), 11.12–554.

11.12–126 551.590.21:061.3(473)

†**Moscow meeting of the Joint Commission on Solar and terrestrial relationships.** *Geo-ysical Journal*, London, 2(4):369–383, Dec. **1959.** 3+2 figs., 22 refs. **DWB, DLC.** Con-ins report of business meeting and colloquium on Solar-Terrestrial Relations (with ab-racts of some papers). The University of Moscow played host on Aug. 12, 1958 to the oint Commission on Solar and Terrestrial Relationships. The Commission discussed the tent to which solar particles penetrate the earth's atmosphere, the relative intensity of the ares, the classification of the perturbed regions, the occurrences and measurements of several ares, the nature of solar corona and the general circulation of terrestrial atmosphere, etc. utstanding Soviet post-war papers on a number of hydrometeorological phenomena were scussed. *Subject Headings:* **1. Solar-terrestrial relationships 2. Solar physics 3. Moscow, .S.S.R. I. International Council of Scientific Unions. Commission for Study of Solar and errestrial Relationships.**—*N.N.* Ⓢ

11.12–127 551.590.21:550.385.4:551.594.51

Cole, K. D. (*Antarctic. Div. Dept. External Affairs, Melbourne*), **Solar-terrestrial rela-onships.** *Nature*, London, 186(4728):874, June 11, **1960.** 9 refs. **DWB**—Considerable vidence exists in favor of much lower proton densities in interplanetary space than was com-only assumed. If the interplanetary density be as low as 1 proton per cm^3 and the resident agnetic field of the order of 10^{-4} gauss then hydromagnetic waves may be propagated from un to Earth all the time. Waves may be guided down the geomagnetic field lines in the rdinary mode while undergoing considerable refraction towards the Earth in the extra-rdinary mode. These waves can cause corpuscular bombardment of the atmosphere. Hence nergy may be transmitted to Earth without actual transit of particles. Earth may capture nough energy to explain magnetic disturbance and aurorae. *Subject Headings:* **1. Solar-rrestrial relationships 2. Geomagnetic disturbances 3. Auroral theories 4. Hydro-agnetic waves from sun.**—*E.Z.S.* Ⓢ

11.12–128 551.501:551.521.1:551.510.534

Biriukova, L. A., **Raspredelenie energii v spektre solnechnykh lucheĭ na raznykh vysotakh.** Spectral energy distribution of solar radiation at various altitudes.] *Moscow. Tsentral'naia erologicheskaia Observatoriia, Trudy*, No. 25:72–76, **1959.** 4 figs., 2 tables, 3 refs. **DLC** -A ethod of computing solar radiation at various altitudes (from 0 to 25.5 km) is described in etail. Consideration is given to distribution of ozone concentration and to absorption of olar radiation by ozone at various altitudes. Computed energy distribution under various onditions is tabulated and plotted on four charts. *Subject Headings:* **1. Solar radiation com-utation 2. Ozone absorption of incoming radiation.**—*N.P.S.* Ⓢ

11.12–129 551.507.362.1:551.510.53:523.7

Friedman, Herbert (*U. S. Naval Res. Lab., Wash., D. C.*), **Sun and upper atmosphere.** *stronautics*, N. Y., 4(7):20–22, 55-56, July **1959.** figs., port., vita. **DLC**—Rocket astronomy as shown that when the Sun is particularly active both its ultraviolet and X-ray emissions ncrease. During IGY remarkable gain was made in the knowledge of the solar spectrum etween Lyman-α and X-ray region. The results of the IGY solar flare program carried out y NRL show that the ionospheric effects accompanying a flare are due to X-ray flashes. ussian scientists find that zodiacal light is produced by scattering from fine cosmic dust ather than from gas. *Subject Headings:* **1. Rocket exploration of the upper atmosphere Solar physics.**—*A.H.K.* Ⓢ

11.12–130 551.510.62:551.521.67:621.396.11 550.385:523.746

Lange-Hesse, Günther, **Variation der brauchbaren Tagesfrequenzen im Kurzwellenweitverkehr als Wirkung solarer Partikelstrahlung.** [Variation of the diurnal useful frequencies used in shortwave long distance communication as an effect of solar corpuscular radiation.] *Archiv der Elektrischen Übertragung*, Stuttgart, 14(3):115 120, March 1960. 4 figs., 12 refs. German and English summaries p. 115. **DLC** The observational data of the ionospheric station Lindau/Harz ($\Phi \approx 52°$) and the geomagnetic observatory Wingst ($\Phi \approx 54°$) is analyzed in order to find the statistical relation between the degree of geomagnetic activity as a measure for the intensity of the incident solar particle radiation and the relative deviations of the factor M3000 and the MUF3000 from their median values (M3000 conversion factor from vertical to oblique incidence critical frequency for 3000-km distance, MUF3000 maximal usable frequency for 3000-km distance). The observational data are arranged only according to the degree of geomagnetic activity, then following average behavior of M3000 and MUF3000 is determined for the different degrees of geomagnetic activity. In the statistical relationship there is a distinct dependence on the sunspot cycle and the seasons. The practical significance of these results is discussed in detail with respect to the prediction of disturbances in short wave propagation conditions. The investigations are also a contribution to the study programmes No. 93(VI) and No. 150(VI) again proposed at the last CCIR-Plenary Assembly (Los Angeles 1959). *Subject Headings:* **1. Geomagnetic activity 2. Solar corpuscular influences on upper atmosphere 3. Shortwave radio propagation 4. Geomagnetic activity-sunspot cycle relationships 5. Lindau, Germany 6. Wingst, Germany.**—*Author's abstract.* Ⓢ

6. ZODIACAL LIGHT

See also: **Sun and upper atmosphere** (Friedman), 11.12–129; **Dust and gas between Earth and Sun** (Redman), 11.12–171.

11.12–131 523.59 551.593.9

Blackwell, D. E., **The zodiacal light.** *Scientific American*, N. Y., 203(1):54–64, June 1960. 10 figs. **DWB, DLC**—Cassini (1683) speculated that the light is caused by a disk-shaped cloud of interplanetary dust that reflects the light of the sun. At the cosmic-ray station in the Bolivian Andes several spectrograms were obtained which show quite clearly the Fraunhofer lines of the solar spectrum. Electron scattering can make only a small contribution to the zodiacal light. Cassini is right; the zodiacal light is due to dust scattering. *Subject Headings:* **1. Zodiacal light theories 2. Interplanetary dust.**—*E.Z.S.* Ⓢ

11.12–132 551.590.25:523.59

Fesenkov, V. G., **On the nature of zodiacal light and its probable connection with asteroids and periodic comets.** *Annales d'Astrophysique*, Paris, 22(6):820 838, 1959. 8 figs., 6 tables, 17 refs. French, English and Russian summaries. **DWB, DLC**—It is shown that the observed particularities of the zodiacal light including its polarization can be accounted for by the scattering of solar light by the fine interplanetary dust particles provided that their properties are the same as that of aerosols always present in the high atmosphere. The supposition about the scattering of light by free electrons is without any observational foundation. Consequently the presence of gas in the interplanetary space cannot be revealed photometrically. The general view of the zodiacal isophotes is almost independent of the character of diffusion function but is intimately connected with the origin of the zodiacal light. Taking the distribution of asteroids or periodic comets according to their angles of inclination, it is possible to deduce the theoretical isophotes of the zodiacal light. The complex of periodic comets represents the observations fairly well but in the case of asteroids an improbable great velocity of dust particles at the moment of disintegration must be assumed. *Subject Headings:* **1. Zodiacal light theories 2. Meteoric dust theory of Zodiacal light.**—*Author's abstract.* Ⓢ

11.12–133 535.51:523.59

Fesenkov, V. G., **Poliarizatsiia zodiakal'nogo sveta po nabliudeniiam v Egipte.** [Polarization of zodiacal light according to observations in Egypt.] *Akademiia Nauk Kazakhskoĭ SSR. Astrofizicheskiĭ Institut, Izvestiia*, 9:3–9, 1959. fig., 6 tables, 2 refs., eq. English

summary p. 8–9. **DLC**—The observations were made with a visual binocular photometer supplied with two polaroid screens placed before the object-glasses and successively rotated per every 60°. The degree of polarization and its orientation toward the vertical circle were determined. It appears that the polarization gradually decreases with angular distance from the sun. It is appeared especially clearly for the morning zodiacal light oriented normally to the horizon. In this case the orientation of polarization is toward the sun. *Subject Headings:* **1. Zodiacal light polarization 2. Egypt.**—*Author's abstract.* Ⓢ

11.12–134 523.59:551.593.55

Fesenkov, V. G., **O zodiakal'nykh sumerkakh.** [Twilight produced by the zodiacal light.] *Akademiia Nauk Kazakhskoĭ SSR. Astrofizicheskiĭ Institut, Izvestiia*, 8:13–18, **1959.** 4 figs., 4 tables, 6 refs., eqs. English summary p. 18. **DLC**—It can be suggested that the brighter parts of the Zodiacal light can produce some illumination of the atmosphere even when hidden by the horizon. In such a case the produced effect appears to be varying very slowly with the azimuth and therefore can produce some apparent enlargement of the observed isophotes of the Zodiacal light. Nevertheless the calculation of the absolute value of this effect shows that it is very small indeed being of the order of 10^{-3} of 5th magn. star per square degree, 10° above the horizon and in a point near the ecliptic. *Subject Headings:* **1. Zodiacal twilight.** —*Author's abstract.* Ⓢ

11.12–135 551.510.536:523.59

Gindilis, L. M. (*Shternberg State Univ.*), **The annual variation in latitude of the gegenschein.** *Soviet Astronomy AJ*, New York, 3(6):1004–1006, May/June **1960.** Fig., 6 refs., 3 eqs. Transl. of **O godichnoĭ variatsii shiroty protivosiianiia.** *Astronomicheskiĭ Zhurnal*, Moscow, 36(6):1091–1093, Nov./Dec. **1959. DLC**—The departure of the center of the gegenschein (counterglow) from the ecliptic, a recently discovered phenomenon, is of great significance in understanding the nature of the gegenschein. The variation in the ecliptic latitude of the gegenschein as a function of its longitude λ, according to data furnished by I. S. Astapovich, D. A. Rozhkovskii, Roach and Rees, Elsässer and Siedentopf, may be represented as a sinusoid of the form $\beta° = 1°.8 \sin(\lambda - 107°)$. Roach's assumption that the material of the zodiacal band is concentrated toward the unaltered Laplacian plane, leads to a sinusoidal curve, of amplitude 2°.7, if we assume the distance to the ring of dust with which the zodiacal band is connected, to be 2.5 a.u. (the mean distance separating the asteroids and the sun). Apparently, the emission of the zodiacal band in the region of the gegenschein has superposed on it emission of a different nature with a maximum at the ecliptic. It is highly probable that this emission is related to the gaseous tail of the earth. *Subject Headings:* **1. Counterglow 2. Outer atmosphere investigations 3. Zodiacal light 4. Gaseous tail of earth's atmosphere.** —*Author's abstract.* Ⓢ

11.12–136 551.510.536:523.59:535.33

Pariiskiĭ, N. N. and Gindilis, L. M. (*both, Acad. Scien., U. S. S. R.*), **Energy distribution in the gegenschein spectrum.** *Soviet Astronomy AJ*, New York, 3(6):992–1003, May/June **1960.** 3 figs., 3 tables, 19 refs., 4 eqs. Transl. of original Russian in *Astronomicheskiĭ Zhurnal*, Moscow, 36(6):1078–1090, Nov./Dec. **1959. DLC**—Observations in the spectral wavelength interval extending from 4200 to 6520 A were carried out, using a superaperture nebular spectrograph at an altitude of 3000 meters, in the vicinity of Alma-Ata ($\varphi = 43°$). The instrumental profile of the spectrograph exhibits a half-width of about 50 A at the violet end of the visible spectrum, and of about 150 A toward the red. The study of a spectrum featuring such low dispersion is equivalent to a study using a continuous array of corresponding interference filters. The energy distribution over the spectrum of the gegenschein (counterglow) for 10 moments (exposures of 30^m) over the course of four nights (September 30 and October 21–24, 1957), is reported. The contrast of the continuous counterglow spectrum at the antihelion point, with respect to the sky background over the average for the four nights, and, for all wavelengths scanned, is 12%. However, this contrast varies strongly from night to night, and, possibly, with wavelength as well. For instance, the contrast on October 23–24 is almost zero, while a bright polar aurora was observed on September 29–30 (during the first half of the night), yielding a contrast averaging better than 20%. Some additional emission evidently

occurred that night at the antihelion (after the termination of the apparent bright phase of the auroral display), this event failing to coincide with the usual night-sky lines and bands. A comparison of the energy distribution at antihelion (after deducting the sky spectrum with all of its components), and the energy distribution in the zodiacal-light spectrum, showed that, averaged over the three "normal" nights of October 21–24, 1957, the energy distribution in the counterglow spectrum was very close to the energy-distribution picture in the zodiacal light, at a distance of 40° from the sun, and comprised about 8.5% of the latter. However, some excess emission of unknown origin evidently occurs in the region λ4300–4400 A. The absolute spectral brightnesses of the counterglow were obtained by reference to a standard radioactive phosphor, which was scanned at the same time in the spectrograph, and night-to-night variations are given, as well as variations with wavelength, for "normal" nights over the 0 to 12 erg/cm²·sec range; steradian $\Delta\lambda = 1$ cm; the range of the "anomalous" night of September 29–30, 1957, extends from 8 to 25 in the same units. *Subject Headings:* **1. Counterglow 2. Spectrographs 3. Outer atmosphere investigations.** *Authors' abstract.* Ⓢ

7. COMETS

See also: **Zodiacal light and its connection with asteroids and comets** (Fesenkov), 11.12–132.

11.12–137 523.66

Marochnik, L. S., **K voprosu o forme obolochek komet.** [On the form of cometary envelopes.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):508–512, May/June **1960.** 3 figs., 13 refs., 10 eqs. Russian and English summaries p. 508. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3), **1960. DLC** —On the basis of Alfven's hypothesis on the interaction between cometary gas and the stream of particles carrying the magnetic field, it is shown that the form of the cometary envelope is represented by a catenary, in accordance with observations. The parabolic dependence, which follows from the mechanical theory of cometary forms, is only a rough approximation. The transversal motions observed in the tails are explained with the help of Alfven waves. The upper limit of the magnetic field is estimated. *Subject Heading:* **1. Comets.**—*Author's abstract.* Ⓢ

11.12–138 523.663

Vorontsov-Vel'iaminov, B. A., **Partial gas densities in Comet 1942g Whipple.** *Soviet Astronomy AJ*, New York, 4(4):674–679, Jan./Feb. **1961.** 2 figs., 10 refs., eqs. **DLC.** Transl. of **Partsial'nye plotnosti gazov v komete 1942g Uippla,** *Astronomicheskiĭ Zhurnal*, Moscow, 37(4):709–715, July/Aug. **1960. DLC**—The absolute monochromatic emission of the comet in the bands CN 3883, C_2 4730 and C_3 4050 was found by reference to stellar spectra, using a spectrogram obtained with an objective prism by Tevzadze on March 11, 1943. Inside the isophote equal to 0.05, at a radius of the coma of 15′ or $3.7 \cdot 10^5$ km, the number of molecules was determined as $1.3 \cdot 10^{33}$, $7.1 \cdot 10^{32}$ and $2.7 \cdot 10^{31}$, respectively. The mass of the coma as a whole was $8 \cdot 10^{10}$ g. The densities varied inversely with the square of the distance from the nucleus. Near the nucleus they were of the order of 10^{11} molecules, and at a distance of $3.7 \cdot 10^5$ km about 2 CN molecules, 1 C_2 molecules and 0.04 C_3 molecules per cm³. The number of molecules calculated from visual brightness according to Zanstra's method is of an order close to that derived by the precise spectrophotometric method. *Subject Headings:* **1. Comet spectra 2. Comet tails.**—*Author's abstract.* Ⓢ

11.12–139 523.663

Stumpff, P., **Die Bewegung der Materie im Schweif des Kometen Morehouse am 29. Oktober 1908.** [The motion of material in the tail of the Morehouse Comet, October 29, 1908.] *Zeitschrift für Astrophysik*, Berlin, 47(4):225–265, **1959.** 13 figs., 12 tables, 14 refs., 44 eqs. **DLC**—The motions of the streamers and of condensations in the tail of the comet Morehouse were obtained from two photographs taken by M. Wolf on Oct. 29, 1908. From the measurements the kinematics and the dynamics of the tail particles are investigated taking into account possible spatial structures of the tail. The accelerations (referred to the gravitational acceleration of the sun) were of the order of 10 for the central part of the tail and increase to about $10^3 - 10^4$ in the outer parts. Both the fact that the acceleration increases

away from the axis, and the order of magnitude reached in the outer part of the tail, are compatible with the mechanism proposed by L. BIERMANN (1951) which takes into account the interaction between the solar corpuscular radiation and the ionized gases in the tail. –An alternative interpretation of the measurements based on the assumption of a low and constant value for the acceleration leads to improbable conditions for the emission of material from the nucleus. It is shown that even if extreme assumptions are made concerning the spatial structure of the tail the above conclusions remain essentially unaltered. *Subject Heading:* **1. Comets.**—*Author's abstract.* Ⓢ

8. METEORS, METEORITES

See also: **Structure of quadrantid meteor stream** (Kashcheev, Lebedinets), 11.12–78; **Zodiacal light and its connection with asteroids and comets** (Fesenkov), 11.12–132; **Photooptical, electronic and calibration apparatus** (Nardonne), 11.12–196; **Statistical investigation of Es layer** (Julák), 11.12–388.

11.12–140 521.23:523.5:778.38

Rozenblium, N. D. (*All-Union Astron. and Geophys. Soc.*), **The use of the photogrammetric method in determining the spatial coordinates of points on a meteor trajectory.** *Soviet Astronomy AJ*, New York, 3(6):974–985, May/June 1960. 2 figs., 13 refs., numerous eqs. Transl. of **Primenenie fotogrammetricheskogo metoda dlia opredeleniia prostranstvennykh koordinat tochek traektorii meteora.** *Astronomicheskiĭ Zhurnal*, Moscow, 36(6):1061–1072, Nov./Dec. **1959. DLC**—The present article outlines the principles and describes the use of stereophotogrammetric instruments in meteor astronomy. In comparison to the "classical" approach, the method proposed here features a pronounced simplification and saving of time in the reduction of meteor plates taken on a common baseline; identical results are obtained. In this article, the stereophotogrammetric technique is applied only to the case where meteors were photographed at zenith. However, it is equally applicable to the general case. *Subject Headings:* **1. Meteor photogrammetry 2. Stereophotogrammetry.**—*Author's abstract.* Ⓢ

11.12–141 523.51/9 523.43

†Whipple, Fred L. (*Smithson. Astrophys. & Harvard College Obs., Camb. Mass.*), **Solid particles in the solar system.** *Journal of Geophysical Research*, Wash., D. C., 64(11):1653–1664, Nov. **1959.** tables, 54 refs. **DLC**—The study of solid particles in the solar system centers chiefly on important researches that should be conducted both in space and from the surface of the earth. Solid particles are defined as particles greater than molecules and smaller than planets. After a survey of current meteoritical results the author discusses some possible types of experiments to be made from space vehicles. The various types of experiments include: (1) impact phenomena by natural particles impinging on exposed surfaces, (2) total velocity vectors of particles in space, (3) erosion on exposed surfaces in space, (4) charge on solid particles in space, (5) composition of meteorites, (6) zodiacal cloud measurements, (7) study of comets, (8) study of asteroids, (9) the physical structure of meteoritic particles and the (10) exploration of the lunar surface. The ground-based meteoritical studies include: (1) basic meteoritic experiments, (2) radio meteor studies, (3) studies of micrometeorites, (4) optical meteor studies, (5) optical studies on the zodiacal cloud, (6) meteorites, (7) studies of meteorite craters, (8) current research by astrophysical methods, (9) studies of asteroids by astrophysical methods and (10) perturbation studies of the motions of astronomical bodies. *Subject Heading:* **1. Meteor research.**—*E.K.* Ⓢ

11.12–142 523.51 523.44

Mason, Brian (*Amer. Museum of Nat. History, N. Y.*), **The origin of meteorites.** *Journal of Geophysical Research*, Wash., D. C., 65(9):2965–2970, Sept. **1960.** 2 figs., 14 refs. **DLC**—Current hypotheses generally interpret chondritic meteorites as being debris from a disrupted planet. It is suggested that these meteorites are not fragments of such a body, but have always been independent and individual objects. They can have been produced by the recrystallization of material now represented by the carbonaceous chondrites. The composition of carbonaceous chondrites is such that if they are heated about 600°C they would give

a mixture of olivine, orthopyroxene, and nickel-iron similar to that of the chondritic meteorites. The friable and porous nature and the chondritic structure of these objects suggest recrystallization essentially in the solid state, as does the intimate admixture of nickel-iron and silicate. The other types of meteorites—achondrites, pallasites, and siderites—can be explained as fragments of a differentiated planetoid or planetoids formed by the aggregation of chondrites. *Subject Heading:* **1. Meteorite origin.**—*Author's abstract.* Ⓢ

11.12–143 523.51

Urey, Harold C. (*Univ. of Calif.*), **Primary and secondary objects.** *Journal of Geophysical Research*, Wash., D. C., 64(11):1721–1737, Nov. **1959.** 10 figs., 4 tables, 19 refs. **DLC** -This richly illustrated study is an account of the subjects that arrive from extraterrestrial sources. Two sets of objects are considered in the chondritic meteorites: 1) primary objects which are of about lunar size, and 2) secondary objects which may be asteroids or the surface region of primary subjects. The author reviews recent and older information on the structure and composition of iron, stony iron and stone meteorites, gives a model for the origin of the meteorites and assumes that the stones and irons generally do not come from the same region of space. Data of cosmic-ray ages of meteorites offer evidence that the ages for the stones are markedly less than those for the iron. At the end of the article the author suggests several experiments in a lunar exploration program which will render valuable information. *Subject Heading:* **1. Meteorites.**—*E.K.* Ⓢ

11.12–144 523.51(237.15)

Russell, John A. (*Univ. of Southern Calif.*), **Some perseid meteor spectra of the past decade.** *Sky and Telescope*, N. Y., 18(10):549–551, Aug. **1959.** 8 figs. (photos). **DWB, DLC**—A discussion of the spectra of some perseid meteors observed by the author in the Sierras during summers starting from summer 1948. The observing site is 1,000 feet above the valley floor of the Feather River near Blairsden, in the Plumas forest district of northeastern California. The area is remarkably free from wind and the sky is very clear. Numerous photographs of different types of meteor spectra nicely illustrate the discussion. *Subject Heading:* **1. Meteor spectra.**—*I.S.* Ⓢ

11.12–145 523.51:551.590.25

Hoffmeister, C., **Der Meteoritenfall von Ramsdorf und einige Probleme.** [The meteoritic shower at Ramsdorf and some problems.] *Die Sterne*, Leipzig, 35(11/12):218–227, Nov./Dec. **1959.** 6 figs., 10 refs. **DLC**—Account of the meteoritic shower at Ramsdorf on July 26, 1958, at 18h30 M.E.T. Determination of weight composition and nature of the fragments. Comments on some unusual circumstances: 1) no fire ball observed; 2) no noise or only faint noise heard; 3) no cloud of evaporated matter observed; 4) the stone shortly after the fall was warm to hot; 5) it did not fall plumb onto the ground. This reminds of the shower at Breitscheid (Aug. 11, 1956). Discussion of some experiments made at the Sonneberg Astronomical Observatory in connection with problems already dealt with and particularly as to why the stones were still warm: tests in the wind-tunnel and warming up of two meteoritic stones (from Norton County and Kunaschak) and of a granite lump. The meteors of Breitscheid and Ramsdorf could belong to the category of the interplanetary bodies whose trajectory in the upper layers of the atmosphere turns into a satellite orbit and which is braked down in the lower layers of the atmosphere when the speed becomes sufficiently small, without reaching the normally observed disintegration. *Subject Headings:* **1. Meteoritic showers 2. Meteors in the atmosphere 3. Ramsdorf, Germany.**—*A.V.* Ⓢ

11.12–146 523.51

Reiffel, L. (*Ill. Inst. Technology, Chicago*), **Erosion of meteorites in space and the density of interplanetary gas.** *Nature*, London, 185(4716):821–832, March 19, **1960.** table, 11 refs. **DWB**—The purpose of this article is to point out that solar protons are probably not the major factors in determining etching rates from sputtering by gas clouds ejected from the sun. Calculated upper limits of interplanetary gas densities and erosion rates near the earth may be changed appreciably as a consequence of including sputtering by elements heavier than hydrogen and are uncertain for other reasons discussed. A table lists proton densities near earth

as inferred from meteoritic erosion rates. *Subject Headings:* **1. Interplanetary matter 2. Meteorite erosion.**—*E.Z.S.* Ⓢ

11.12–147 523.51

Nichiporunk, Walter and Chodos, Arthur A. (*both, Calif. Inst. of Technology, Calif.*), **The meteoritic iron sulfide nodules.** *Journal of Geophysical Research*, Wash., D. C., 64(12):2451–2463, Dec. **1959.** fig., 11 tables, 25 refs., 2 eqs. **DLC**—The concentrations (based on graphite-free nodules) of vanadium, chromium, cobalt, nickel, copper, zinc, and iron have been determined by X-ray fluorescence analysis in twenty-two troilite nodules from twelve iron and two silicate meteorites. These elements were determined, in addition, in the del Norte County California, terrestrial troilite. It was found that the concentration ranges of the elements are extremely broad and do not differ greatly for the three types of troilites studied. The elements chromium and nickel, which are present in the largest concentrations, are distributed over the ranges which also appear to be the broadest. The copper range is the narrowest, and the cobalt range is comparable to that of nickel. Since in most cases concentrations of vanadium, zinc, and arsenic lie below the respective detection limits, the effective concentration ranges for these elements may be as broad as, if not broader than, the ranges for the other elements. The content of iron varies within wider limits than those defined by all iron values, previously reported. An abundant free-iron phase which occurs in troilite nodules indicates that a complete segregation of the iron sulfide and iron phases was not attained. *Subject Heading:* **1. Meteorite composition.**—*Authors' abstract.* Ⓢ

11.12–148 523.165:523.51

†Signer, P. and Nier, A. O. (*both, Univ. Minnesota*), **The distribution of cosmic-ray-produced rare gases in iron meteorites.** *Journal of Geophysical Research*, Wash., D. C., 65(9):2947–2964, Sept. **1960.** 12 figs., 4 tables, 22 refs., 3 eqs. **DLC** The cosmogenic Ar^{38}, Ar^{36}, Ne^{22}, Ne^{21}, Ne^{20}, He^{4}, and He^{3} distribution in part of a cross section of the iron meteorite Grant has been measured. The amounts were found to vary systematically with depth. The depth effect was analyzed in terms of a production mechanism, and numerical parameters were determined. Comparisons were made with the results of other investigations. Functional relationships correlating relative amounts of cosmogenic nuclides with position and size of a meteoritic body are demonstrated. In principle the determination of a sufficient number of cosmogenic nuclides in a single sample permits deductions about the radiation dosage and the size of the meteoroid as well as the location of the sample within the body. *Subject Headings:* **1. Meteoritic gases 2. Cosmic ray effects on meteorites.**—*Authors' abstract.* Ⓢ

11.12–149 523.51:551.521.64

Whipple, F. L. and Fireman, E. L., **Calculation of erosion in space from the cosmic-ray exposure ages of meteorites.** *Nature*, London, 183(4671):1315, May 9, **1959.** 4 refs. **DLC**—An upper limit to the erosion rate of an iron meteorite with an exposure age of 5×10^{8} years is estimated at 1.5×10^{-7} cm/year. This new evaluation of cosmic-ray exposure age and rate gained by a meteorite in space is based on a study of argon exposure age of the large Sikhote-Alin meteorite whose radioactive isotope has a half-life of 260 years. The estimated rate is smaller than reported previously. *Subject Headings:* **1. Cosmic ray effects on meteorites 2. Age of meteorites.**—*N.N.* Ⓢ

11.12–150 550.382.3:523.51

Lovering, John F. (*Dept. of Geophysics, Australian Nat. Univ., Canberra*), **Magnetic field in primary meteorite body.** *American Journal of Science*, New Haven, Conn., 257(4):271–275, April **1960.** 2 figs., table, 10 refs. **DLC** (Q1.A5)—The magnetic properties and mineralogical composition of the Moore County eucrite indicate that, while situated within about 10 km of the surface of the silicate mantle of a primary meteorite body, this meteorite cooled through the Curie temperature of its magnetic constituents (about 560°C) while in a magnetic field. If this field associated with the primary body was generated within a fluid metallic core, then at this time temperatures within the core must have been greater than about 1700°C. Furthermore the inclination of the direction of magnetization with the horizontal plane of crystal layering observed in the meteorite suggests that the Moore County eucrite formed

close to either the 10°N or 10°S magnetic latitude of the primary body. *Subject Heading:* **1. Meteorite magnetism.**—*Author's abstract.* Ⓢ

11.12–151 550.382.3:532.51

Stacey, F. D. and Lovering, J. F. (*Dept. Geophysics, Australian Nat'l. Univ., Canberra*), **Natural magnetic moments of two chondritic meteorites.** *Nature*, London, 183(4660):529–530, Feb. 21, **1959.** fig., 8 refs. **DLC**—Substantial natural magnetic moments were found in three chondrites. Two of them (Homestead and Mount Browne) were used in thermal demagnetization experiments to obtain information about the origin of their moments. The Homestead meteorite is a polymict, brecciated grey bronzite-chondrite with 1 percent magnetite and 9 percent metal by weight. The Mount-Browne chondrite is similar but with a higher proportion of metal. The details of demagnetization experiments are presented and graphically illustrated. *Subject Heading:* **1. Meteorites.**—*I.S.* Ⓢ

11.12–152 525.3:523.51

Brown, Harrison (*Calif. Inst. of Technology*), **The density and mass distribution of meteoritic bodies in the neighborhood of the earth's orbit.** *Journal of Geophysical Research*, Wash., D. C., 65(6):1679–1683, June **1960.** 3 figs., 3 tables, 3 refs. **DLC**—A study of the frequency of meteorite falls in areas which have been highly populated throughout the last century indicates that the average rate of fall of meteorites on the earth probably lies between 0.32 and 1.0 falls/year/10^6 km^2. The frequency of fall as a function of type and mass has been studied, and it is shown that the distribution curves for stones and irons have similar shapes. The curves are also remarkably similar to those observed for asteroids. The observed relationships are used to calculate the impact frequency of meteoritic particles upon the earth and moon as a function of their size. *Subject Headings:* **1. Meteorite frequencies 2. Moon.**—*Author's abstract.* Ⓢ

11.12–153 551.501.81:523.51

Fialko, E. I. (*Tomsk Polytechnic Inst.*), **A method for studying the distribution by mass of meteoric bodies.** *Soviet Astronomy AJ*, New York, 3(6):970–973, May/June **1960.** fig., 10 refs., 11 eqs. Transl. of **Metod issledovaniia zakona raspredeleniia meteornykh tel po massam.** *Astronomicheskiĭ Zhurnal*, Moscow, 36(6):1058–1060, Nov./Dec. **1959. DLC** – The method outlined may be used to study the mass distribution pattern of meteoric bodies, by utilizing the distribution by duration of persistent radio echoes returned from meteor trails. Experimental results from the application of this method to the Perseid shower are presented. *Subject Headings:* **1. Meteor mass 2. Radio echoes from meteor trails 3. Meteor echo duration.**—*Author's abstract.* Ⓢ

11.12–154 551.507.362.2:523.51

Manring, Edward R. (*U. S. Air Force, Hanscom Field, Bedford, Mass.*), **Micrometeorite measurements from 1958 Alpha and Gamma satellites.** *Planetary and Space Science*, N. Y., London, 1(1):27–31, Jan. **1959.** 5 figs., 3 refs. **DLC** –Grid abrasion micrometeorite detectors mounted on 1958 Alpha and Gamma satellites give a maximum influx rate of particle 10μ in diameter or larger for the period 1 February to 7 May 1958. On 7 May 1958 two detectors appeared to indicate impacts on 1958 Gamma. The failure within a few days of all electronics on the satellite open the possibility that a shower was encountered with meteor damage subsequently destroying electronics; or of an electronics failure which first manifested itself in the meteorite detection gear. *Subject Headings:* **1. Satellite observation of meteors 2. Micrometeorites 3. U. S. satellite 1958 alpha (Explorer I) 4. U. S. Satellite 1958 gamma (Explorer III).**—*Author's abstract.* Ⓢ

11.12–155 551.507.362.2:621.395.51:534.321.9:523.51

Oklahoma. State Univ., Stillwater. Research Foundation, **Research directed toward the design, development, and construction of meteoritic microphone detectors of various sensitivities for use in satellites.** Contract AF 19(604)-5715, Scientific Report No. 1, Jan. 15, **1960.** 20 p. 13 figs., 2 plates, charts —An electronic system designed for the express purpose of exploiting the data-gathering potential of a specific vehicle in obtaining information regarding

the influx of micrometeor material has been developed. An acoustic sensing technique is employed, whereby the particulate matter to be detected activates a supersonic microphone device. The resultant electrical signal is amplified to a suitable level, graded as to magnitude, and stored internally by electronic means for subsequent recording and/or telemetering to ground receiving stations by the system inherently available within the chosen vehicle. A brief historical background of the development of the technique is presented, together with details of the specific system evolved for this application. Various design features which are peculiar to this application are presented and discussed. The prototype equipment which resulted from the development program has been subjected to a testing program to verify its suitability for the anticipated use, and several sets are currently under construction. *Subject Headings:* **1. Micrometeorites 2. Satellite meteor observation techniques.**—*Author's abstract.* Ⓢ

11.12–156 523.5

Mirtov, E. A., **O mekhanizme obrazovaniia meteornogo sleda.** [Mechanism of formation of a meteor trail.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):513–516, May/June **1960.** 2 figs., 7 refs., 3 eqs. Russian and English summaries p. 513. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3):485–488, **1960. DLC** —It is shown that molecules escaping from a meteor body have a possibility, before their first collision with molecules of the medium, of moving away from the meteor body. The distance is larger, the greater the velocity of the molecule. Thus there is a division of molecules of evaporating meteor matter, which have small thermal velocities, from molecules of the air which are repelled from the surface of the meteor with exceedingly large velocities. In connection with this the double trail observed for some fast meteors can be explained: the outer ionized cylinder should be of atmospheric origin, the inner bright and narrow core —mainly of evaporating meteor matter origin. *Subject Heading:* **1. Meteor trail theories.**—*Author's abstract.* Ⓢ

11.12–157 551.501.81:523.5

Peregudov, F. I., **Zavisimost' vremeni registratsii meteornykh otraxheniĭ ot parametrov radiolokatsionnoĭ stantsii.** [The dependence of the time of registration of meteor reflections on the radar system parameters.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):530–535, May/June **1960.** 2 figs., 8 refs., 17 eqs. Russian and English summaries p. 530. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3):502 507, **1960. DLC** In scientific literature the duration of meteor reflections is estimated at the relative level. This method of measurement of duration is suitable if there is amplitude indication and can lead to essential errors, due to resonance phenomena in the trail. It is more expedient to obtain the time of registration of the meteor reflection, determined by the threshold signal or discrimination level. Theoretical formulas are given for computing the time of registration of reflections from meteor trials of the unstable type. A condition is given for the detection of unstable type trails by a radar system. The deduced formulas are confirmed by McKinley's experiments. *Subject Headings:* **1. Radar observation of meteors 2. Meteor echo duration.**—*Author's abstract.* Ⓢ

11.12–158 523.5:521.75:551.594.12

Furman, A. M., **K teorii ionizatsii meteornykh sledov, I, Kinetika izmeneniia ionizatsionnykh parametrov meteornykh tel pri ikh razogreve vo vremia dvizheniia v atmosfere Zemli.** [Theory of ionization of meteor trails, Pt. 1, The kinetics of the variation of the ionization parameters of meteor bodies during their motion in the Earth's atmosphere.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):517–525, May/June **1960.** 5 tables, 18 refs., 12 eqs. Russian and English summaries p. 517. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3):489–497, **1960. DLC**—It is shown that the ionization parameters (i.e. the work function of the electron, positive ion, ionization potential of the atom and the probability of evaporation of a neutral (atom) of a meteor body vary as it heats up during its motion in the earth's atmosphere and as its fractions with lowest boiling points evaporate. The oxides, alkaline and alkaline-earth metals contained in stony and iron-stony meteors provide for the low values of the work function of the electron and positive ions. As a result of the process of continuous "blowing-off" of particles from the surface of a meteor body by the encountered flow of gas molecules, which excludes the formation of space charges and due the emission of charged particles of both signs, dynamic equilibrium between emission intensities of electrons and positive ions sets in

Directions for the computation of equilibrium values of the work function for electrons and positive ions are given. The noted circumstances give grounds for the reconsideration of existing concepts on the theory of ionization of meteor trails. *Subject Headings:* **1. Meteor ionization trails.**—*Author's abstract.* Ⓢ

11.12–159 551.590.25:551.510.53:551.594.12

Dokuchaev, V. P. (*Radio Physics Scientific Research Inst. at Gorkiĭ Univ.*), **Formation of an ionized meteor trail.** *Soviet Astronomy AJ*, New York, 4(1):106–109, July/Aug. **1960.** 9 refs., 13 eqs. **DLC.** Transl. of **Formirovanie ionizirovannogo meteornogo sleda.** *Astronomicheskiĭ Zhurnal*, Moscow, 37(1):111–114, Jan./Feb. **1960. DLC**—The distribution of ionized gas in the wake of a meteor trail through the upper layers of the atmosphere is discussed. A solution is found for the diffusion equation in the presence of an ion source traveling at constant velocity at a small angle to the horizon. It is shown that the plasma concentration in the vicinity of the moving meteor is appreciably greater than in the remainder of the meteor wake. The conditions under which the trail may be approximated to a cylinder with a Gaussian distribution for the plasma concentration as radius are found. *Subject Heading:* **1. Meteor ionization trails.**—*Author's abstract.* Ⓢ

11.12–160 551.551.8:523.5

Greenhow, J. S. (*Univ. of Manchester, England*), **Eddy diffusion and its effect on meteor trails.** *Journal of Geophysical Research*, Wash., D. C., 64(12):2208-2209, Dec. **1959.** 2 figs., ref. **DLC**—Information about the small-scale turbulence at heights near 90 km has been obtained from photographic meteor trails. The time constant of the smallest eddies is found to be approximately 30 sec, and the turbulence power to be 70 ergs g^{-1} sec^{-1}. *Subject Headings:* **1. Eddy diffusion in upper atmosphere 2. Meteor trail turbulence observations.**—*Author's abstract.* Ⓢ

11.12–161 551.501.8:551.557:523.5

Elford, W. G. (*Dept. of Physics, Univ. of Adelaide, S. Austra.*), **A study of winds between 80 and 100 km in medium latitudes.** *Planetary and Space Science*, N. Y., 1(2):94–101, April **1959.** 8 figs., tables, 9 refs. **DWB**—Results of a systematic investigation of winds in the upper atmosphere by the radio observation of drifting meteor trails are described. It is shown that in medium latitudes the diurnal behavior of the winds in this region can be described in terms of three horizontal components of comparable magnitude; a prevailing component and two oscillatory components with periods of 24 and 12 hrs. The prevailing winds are predominantly zonal and are directed toward the East during most of the year. Large wind gradients are present in summer and winter. In general the periodic components represent anticlockwise rotation of the wind vectors. The seasonal variations in the magnitude and phase of the 24-hr oscillation suggest a direct thermal origin for this component. The amplitude and phase of the 12-hr component vary in a complex manner throughout the year, but the mean amplitude increases with height. *Subject Headings:* **1. Upper air winds 2. Meteor trail wind observation techniques.**—*Author's abstract.* Ⓢ

11.12–162 621.396.9:523.5

Roessler, E. (*Berlin*), **Streuausbreitung von Funkwellen durch Meteorite.** [Scatter propagation of radio waves by means of meteorites.] *Umschau*, Frankfurt a.M., 59(19):598, Oct. 1, **1959. DLC**—Canadian engineers have developed a technique for utilizing meteorites or the ionic traces produced by them in the propagation of meter waves. Meteoritic scattering is substantially stronger than the ionospheric so that simpler direction antennas and capacities of less than 1 kw can suffice. The cosmic dust bodies, of which the meteorites are a part, continually penetrate into the upper layers of the atmosphere and ionize the air; approximately every second they produce transmission of short duration of about 0.1 second. Despite these short and intermittent transmissions a directional radio transmission can be carried on especially for telegraphy and television, even though meteoritic scattering is not always present. It is simply necessary that a sender (at station A) continually transmit carrier waves with a message until a receiver (at station B) reports their reception. For this return report there

are used a sender of station B and a receiver at station A. The telegrams are fed in the usual manner as punched tape. The process of transmission by this method as carried out in Canada is outlined briefly. *Subject Headings:* **1. Radio wave propagation by meteor ionization trails 2. Scatter propagation.**—*I.L.D.* Ⓢ

11.12–163 523.5:551.590.25:550.385

Jenkins, Alvin W., Jr. and Phillips, Charles A., Jr. (*both, Denver Univ.*) and Maple, Elwood (*GRD, AF Camb. Res. Center*), **Observed magnetic effects from meteors.** *Journal of Geophysical Research*, Wash., D. C., 65(5):1617–1619, May **1960.** fig., 2 refs. **DLC**—A preliminary analysis of data recently available from the IGY program concerned with subaudio fluctuations in the geomagnetic field seems to indicate that meteoric activity and the average level of the fluctuations are related. *Subject Headings:* **1. Meteor influences on geomagnetic field 2. Geomagnetic fluctuations.**—*E.Z.S.* Ⓢ

11.12–164 551.510.42:551.590.25:551.521.7

Dmitriev, A. A., **K voprosu o skorosti rasprostraneniia melkoĭ kosmicheskoĭ materii iz verkhnikh sloev atmosfery vniz.** [The speed of propagation of fine cosmic matter from the upper atmospheric layers downward.] *Akademiia Nauk SSSR, Izvestiia, Ser. Geofiz.*, No. 10:1468–1472, Oct. **1959.** 2 figs., 13 refs., 28 eqs. **DLC** Cosmic dust and products of combustion of meteors, turbulently moving downwards, are considered carrying some quantity of aerosol from space to upper atmospheric layers. The characteristics of these masses, evaluated by different investigations, are reviewed in respect to their velocities in downward movement. The author presents his own considerations of movements of the cosmic particles with mathematical expressions of the coefficients of turbulent kinematic velocities, varying with altitude. *Subject Headings:* **1. Meteoric dust 2. Cosmic particles.**—*N.P.S.* Ⓢ

11.12–165 523.165:523.51:551.46:552.6

Hunter, W. and Parkin, D. W. (*both, Department of Physics and Mathematics, College of Technology, Liverpool*), **Cosmic dust in recent deep-sea sediments.** *Royal Society of London, Proceedings, Ser. A*, 255(1282):382–397, April **19, 1960.** 8 figs., 2 tables, 13 refs. **DWB, DLC** (Q41.L7)—By means of a simple density-measuring technique, black magnetic cosmic spherules, found in the deep-sea surface sediments, can be divided into two main groups. Further analysis shows the spherules of the first group (density about 3) to be a fine-grained magnesium-rich olivine; and those of the second group (density about 6) to be a partially oxidized nickel+iron alloy. These results strongly indicate a meteoritic origin, and, following Öpik 1956, it is suggested that the spherules are derived from the Zodiacal Cloud. The expected amount of zodiacal material accreted to the earth is in fair agreement with direct observation, and it is tempting to regard the cloud as a swarm of small dust flakes produced by the collision of meteoritic (or asteroidal) bodies. Interaction with the upper atmosphere, at speeds near the earth's escape velocity, would cause some of the larger flakes to melt, and in the case of olivine this would account for its blackened magnetic state. Only the magnetic fraction of the sediments have been examined; it is not known whether other extra-terrestrial material is present in the non-magnetic portion. Over 260 spherules were extracted from two Atlantic samples and one Pacific sample. A very simple method for comparing the recent rates of sedimentation for the various parts of the oceans is suggested. The size distributions of the spherules are discussed in terms of Whipple's micro-meteorite theory. The minimum size of the iron spherules, occurring at about 15μ diameter, is used to account for an unexpected depression or 'forbidden region' in the stony size distribution near 60μ. Since the smallest stony spherules found were about 18μ, it may be suspected that our observations were limited to sizes above about 15μ. This may be true, as settling-out techniques had to be used in order to rid the sediment of fine magnetite grains, particularly troublesome in the Atlantic samples. However, on occasions the settling process was omitted for the Pacific sediment and careful attention paid to the smaller particles; no spherules below about 15μ could be found. It is very important to obtain the correct lower limit of the size distributions, and the examination of magnetite-free sediments would be extremely helpful in any future work. *Subject Headings:* **1. Cosmic dust 2. Deep sea sediments.**—*Authors' abstract.* Ⓢ

9. PLANETS, INTERPLANETARY MATTER

A. General

See also: **Planetary photography** (Kirby), 11.12–21; **Color photographs** (Seitter), 11.12–22; **Model solar systems** (Chamberlain), 11.12–27; **Radio emissions from planets** (Section A4D), 11.12–63 to 11.12–67; **Erosion of meteorites and density of interplanetary gas** (Reiffel), 11.12–146.

11.12–166 521.151:523.7:523.45/46:551.11

Schoenberg, Erich (*Rimsting am Chiemsee*), **Die äquatoriale Beschleunigung bei Sonne, Jupiter und Saturn, nebst Betrachtungen über die Form der Kontinente.** [The equatorial acceleration of the Sun, Jupiter and Saturn, and observations on the form of continents.] *Geofisica Pura e Applicata*, Milan, 43:1–11, May/Aug. **1959.** 5 figs., 7 tables, 7 refs., 7 eqs. German and English summaries, p. 1. **DWB, DLC** The hypothesis of R. Emden to explain the equatorial acceleration of the Sun has newly been discussed by the author and 11 years ago applied to the rotation of the planet Jupiter. It is possible to apply it also to the planet Saturn and to the earth in the archaic period of evolution. The Earth shows a striking eastern curvature of the continents in the equatorial zone, which possibly has originated in times when the Earth's crust was capable to yield to the same forces which drive the equatorial zone forwards in rotating gaseous and liquid spheres, as the Sun and the great planets. It is necessary to suppose an invariable position of the pole and the principal height differences of the crust already developed. It is found, that the viscosity of the Earth in that time has been small in comparison to its present value (10^{14} to 10^{20} c.g.s.). *Subject Headings:* **1. Sun's rotation 2. Rotation of planets 3. Continent formation.**—*Author's abstract.* Ⓢ

11.12–167 521.5:523.4 523.164:525.3

Günther, O., **Möglichkeiten zur Bestimmung der Rotationsperiode eines Planeten.** [Possibilities of determining the rotation period of a planet.] *Die Sterne*, Leipzig, 36(5/6):97–104, May/June **1960.** 3 figs., 2 tables, 27 refs. **DLC**—The different possibilities of determining the rotation period of certain planets are analyzed. The author begins with some considerations on the rotation period of the Earth and explains the two most widely used corrections. Successive paragraphs deal with: the determination of rotation period by observation of surface details; the spectrographical determination of rotation speed; the theoretical calculation of rotation period, the determination of rotation period from radio astronomical observations. A table gives the best values for rotation periods of major and minor planets. *Subject Headings:* **1. Rotation of planets 2. Rotation of the earth.**—*A.V.* Ⓢ

11.12–168 551.521.64:523.152.2

Reiffel, L. (*Armour Res. Found., Chicago, Ill.*), **Low-energy X-rays from interplanetary space.** *Nature*, London, 185(4708):229, Jan. 23, **1960.** 6 refs. **DWB**—Theoretically, it is expected that the steady gas stream from the sun will finally become unstable at some radial distance from the sun and establish a region of highly disordered interplanetary magnetic field and plasma. Energy interchange processes between the heavy ions and the electrons of the plasma which may be expected to occur in this disordered region of hydromagnetic turbulence should lead to a diffuse source of low-energy cosmic X-rays which may be observable at altitudes greater than about 120 km. The radiation might best be observed on the right side of the Earth. Collimated detectors might be used to advantage to look for structure, for example, higher intensity in the plane of the ecliptic or patchiness in the interplanetary gas X-ray source, and to discriminate against stellar backgrounds and auroral X-rays from the Earth. *Subject Headings:* **1. Cosmic radiation 2. Interplanetary X-radiation.**—*E.Z.S.* Ⓢ

11.12–169 523.755

Parker, Eugene (*Univ. of Chicago*), **Extension of the solar corona into interplanetary space.** *Journal of Geophysical Research*, Wash., D. C., 64(11):1675–1681, Nov. **1959.** 4 figs. **DLC**—The first part of the paper presents a number of observational facts concerning the problem

of the interplanetary gas. The observations considered most relevant include: a) the solar corona, its density and temperature, b) corpuscular streams blowing outward from the sun, the velocity of the streams in correlation to the sun's activity, c) the ionization of interplanetary gas and its good electric conductivity, d) dipole-like field toward the polar region, e) the solar magnetic field, its rapid extension, f) the increase of cosmic-ray intensity at the arrival of the flare particles. In the second part we find the summary of the theoretical results. The velocity of the outward expansion of the solar corona and the resulting gas density at the orbit of the earth, the decrease of cosmic-ray intensity in the vicinity of the earth and the origin of 11 year cycle in the cosmic ray intensity are discussed. Finally the terrestrial effects of the solar wind are considered. *Subject Headings:* **1. Corona structure 2. Interplanetary gas 3. Solar effects on cosmic rays 4. Solar-terrestrial relationships.**—*E.K.* Ⓢ

11.12–170 523.745:551.590.21

Gold, Thomas (*Harvard College Obs., Camb., Mass.*), **Plasma and magnetic fields in the solar system.** *Journal of Geophysical Research*, Wash., D. C., 64(11):1665–1674, Nov. **1959.** 7 figs., 3 refs. **DLC**—The author attempts to answer the question: what are the conditions of the interplanetary gas in the inner part of the solar system. The subject is the counterpart to meteorology on the earth. The author assumes that the interplanetary gas probably consists predominantly of protons and electrons; since it is almost certainly highly ionized, magnetic fields will move with the gas. It is suggested that there are two types of sources on the sun that send material to the earth. One of these sources resides in the chromosphere, and there is probably another source consisting of coronal material. Magnetic configurations that must result from solar outbursts were studied and suggested shapes of magnetic field lines are presented. The author points to the fact that a magnetic field carried with the solar plasma deflects the cosmic rays and produces on the earth a magnetic storm phenomenon. But cosmic rays excluded from a certain region can also be confined in that region if they are produced inside it. Observational evidence leads to the conclusion that the same magnetic region is capable of both including and excluding particles, that the particles of solar origin are captured within it and the external cosmic rays are excluded from it. The region in the vicinity of the earth in which the earth's magnetic field dominates all dynamical processes might be called the magnetosphere. Ionospheric effect produced by low-energy particles, the separation of the radiation belt into two zones and the diurnal variation in the geomagnetic field are discussed. *Subject Headings:* **1. Solar magnetism 2. Interplanetary gas 3. Solar influences 4. Van Allen belts 5. Radiation regions.**—*E.K.* Ⓢ

11.12–171 523.16 523.59 523.755

Redman, R. O. (*Cambridge, Eng.*), **Dust and gas between the earth and the sun.** *The Observatory*, London, 79(912):172–181, Oct. **1959. DLC** –The author gave the Halley Lecture for 1959 at Oxford on May 14. He summarizes his presentation by pointing out that we believe there is a fairly continuous distribution of gas and dust between us and the sun but we are uncertain whether the material originates mostly by ejection from the Sun, or is a more or less permanent feature of the solar system, or is being accreted from interstellar matter. If there is a kind of dynamic equilibrium between these sources of supply how does the system work. The author refers to the works of VON KLIIBER and BLACKWELL, commenting on BLACKWELL'S effective use of conventional aircraft for photographing the zodiacal light and the outer corona. *Subject Headings:* **1. Interplanetary dust 2. Interstellar matter 3. Zodiacal light.**—*E.Z.S.* Ⓢ

11.12–172 551.510.53:551.594.12

Shklovskiĭ, I. S., **The Earth's corona.** *The New Scientist*, London, 8(198):591–593, Sept. 1, **1960.** 2 figs., photo. **DLC**—Experiments were carried out in Soviet space probes to study the ionized gas of interplanetary space and the outer parts of the Earth's atmosphere. A description is given of the instrumentation. A group of astrophysicists who took part in analyzing the results was headed by the author. It is claimed that the results show that the Earth, like the Sun, has a corona. It can be traced to 22,000 km. *Subject Headings:* **1. Interplanetary gases 2. Rocket instrumentation 3. Earth's corona.**—*R.B.* Ⓢ

B. Pluto, Jupiter, Mars, Venus

See also: **Radio radiation from Venus** (Kraus), 11.12–65; **960 Mc/s radiation from Jupiter** (Radhakrishnan, Roberts), 11.12–66; **Radiation from Jupiter at decimeter wavelength** (Field), 11.12-67; **Round-trip trajectoris for Mars observation** (Johnson, Smith), 11.12–515.

11.12–173 523.482

Gingerich, Owen, **The solar system beyond Neptune.** *Scientific American*, N. Y., 200(4): 86–100, April **1959.** 5 figs. **DWB, DLC** Pluto, most remote and mysterious among the planets, is the object of many theories, some of which appear to indicate that it gave birth to our present solar system. The history and results of human endeavor to understand Pluto are discussed in detail. Other planets are also examined in comparison. *Subject Heading:* **1. Pluto.**—*N.N.* Ⓢ

11.12–174 523.43

Meeus, Jean, **Oppositions of Mars, 1960 to 1980.** *British Astronomical Association Journal*, 70(3):144–145, March **1960.** table. **DWB, DLC**—Dates are given of oppositions of Mars for the period 1960–80. The last column in the table gives planetographic latitude of the center of Mars' disk at the date of opposition. The other values were computed with the aid of planetary co-ordinates. *Subject Heading:* **1. Mars.**—*A.H.K.* Ⓢ

11.12–175 521.241.1:523.42

Pauscher, H. (*Potsdam-Babelsberg*), **Drei Messreihen zur Bestimmung des Venusdurchmessers.** [Three series of measurements to determine the diameter of Venus.] *Astronomische Nachrichten*, Berlin, 285(4):174–180, March, **1960.** 3 figs., 6 tables, 5 refs., 7 eqs. German summary p. 174. **DLC**—Three series of measurements were used for determining the diameter of Venus. The measurements were made from April to June 1956 by Dick, Hintze, and Pauscher. Their measurements are compared and a formula is developed to calculate the horizontal refraction using a lense of 10 m focal distance. *Subject Heading:* **1. Venus diameter.**—*E.Z.S.* Ⓢ

C. Moon

See also: **Camera for observation of the Moon** (Potter, Streletskiĭ), 11.12–17; **Radio image of Moon** (Amenitskiĭ et al.), 11.12–64; **Radio signals reflected from the Moon** (Blevis, Chapman), 11.12 76; **Roughness of Moon as radar reflector** (Hughes), 11.12–77; **Distribution of meteoritic bodies** (Brown), 11.12–152; **Lunar influence on Es** (Knecht), 11.12–389; **Scientific problems in cislunar space** (Singer), 11.12–520; **U. S. Moon rocket Pioneer IV** (Current Science), 11.12–524; **Third Soviet cosmic rocket** (Priroda), 11.12–528; **Russian space rocket** (Nature), 11.12–529; **Lunik III** (Current Science), 11.12–530.

11.12–176 523.22:523.3

Urey, H. C., **The origin and nature of the moon.** *Endeavour*, London, 19(74):87–99, April **1960.** 5 photos, 10 refs. **DLC**—Present theories are discussed and inferences concerning lunar structures as derived from photographs of the far side of the moon, are suggested. A meteoric, the socalled Imbrian, collision seems mostly responsible for the moon's surface. The pictures of the other hemisphere of the moon did not yield any very important conclusion about the structure and history of the moon. The possibility that radioactivity played an important part in shaping the moon and the possibility of placing seismographs on its surface and securing samples for the meteorologist would supplement our astronomical knowledge with physical and chemical studies. The usual processes of geology, however, had little effect on the moon in the author's opinion. The photographs are from the journal *Sky and Telescope* (1956). *Subject Heading:* **1. Moon.**—*O.T.* Ⓢ

11.12–177 523.33

Alexandrov, Igor (*U. C. L. A.*), **The lunar gravitational potential.** *Advances in the Astronautical Sciences*, New York, Vol. 5, **1959,** issued **1960.** p. 320–324. 5 refs., 19 eqs. **DWB**

(629.1388 A512pro), **DLC** (QB1.A26)—Deviations from sphericity of the moon are betrayed by both photographic measurements of the disk and observations of the physical librations. By employing the best of these data, and assuming the shape of the moon to be a triaxial ellipsoid, the ratios of the moments of inertia are obtained from physical libration data, whereas two of the three axis of the ellipsoid are determined from photographic measurements of the disk. These data yield the length of the third axis. The semimajor axes of this triaxial ellipsoid are 1738.57±0.07 km, 1738.21±0.07 km, and 1737.49±0.07 km. The lunar potential in a lunicentric system is then calculated by assuming further that the density distribution is given by a compressional model. *Subject Headings:* **1. Moon 2. Lunar gravitation.**—*Author's abstract.* Ⓢ

11.12–178 523.3:535.243

Teĭfel', V. G. (*Acad. Scien., KazSSR.*), **The difference in the spectral properties of areas on the lunar surface.** *Soviet Astronomy AJ*, New York, 3(6):955–959, May/June **1960.** 2 tables, 8 refs. Transl. of **O razlichiiakh spektral'nykh svoĭstv uchastkov lunnoi poverkhnosti.** *Astronomicheskiĭ Zhurnal*, Moscow, 36(6):1041–1046, Nov./Dec. **1959. DLC**—The results of the spectrophotometric measurement of 90 lunar areas in the interval λλ390–620 mμ are considered. The spectral curves for these areas, constructed relative to a reference area in Mare Vaporum, are characterized by an almost monotonic variation of intensity along the spectrum, and this allows the color indices to be used for the determination of the color of lunar objects. The maximum difference in the spectral curves, expressed in relative spectrophotometric gradients, is 0.57 for λλ390–500 mμ and 0.72 for λλ510–620 mμ, i.e., it does not exceed 0.6 of the spectral class dG. *Subject Headings:* **1. Moon's surface 2. Spectrophotometric observations of Moon.**—*Author's abstract.* Ⓢ

11.12–179 523.322:523.035.312.12

Fesenkov, V. G., **Fotometricheskie osobennosti Luny.** [Photometrical peculiarities of the moon.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):496–500, May/June **1960.** 2 figs., 2 tables, 8 refs., 4 eqs. Russian and English summaries p. 496. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3):468–472, **1960. DLC**—It is shown that all the fundamental properties of the Moon can be accounted for by a rather simple formula, originally due to Lommel-Seeliger. It includes only one function which is determined from observations, namely the relative brightness of the positive edge of the lunar crescent. A physical interpretation of the formula is possible only if it is assumed that the surface layer of the Moon is a combination of comparatively large grains, very feebly bound together and capable of scattering light in a backward direction, partially shading each other. *Subject Headings:* **1. Moon's surface 2. Lunar photometry.**—*Author's abstract.* Ⓢ

11.12–180 551.507.362.2:551.508.85:523.3

Fensler, W. E.; Senior, T. B. A. and Siegel, K. M. (*all, Michigan Univ.*), **Exploring the depth of the surface layer of the Moon from a radar space observatory.** *Aero/Space Engineering*, N. Y., 18(11):38–41, Nov. **1959.** 4 refs., 5 eqs. **DLC**—The method given here involves the determination of the power reflection coefficient at different wavelengths; this coefficient is a function of the number and depth of any layers present and of the electromagnetic constants associated with these layers. Using the mathematical formula for the reflection coefficient of a layered structure, these quantities can be calculated from measured values of the power return at different wavelengths. It is suggested that this experiment be carried out by placing a radar-equipped satellite in orbit around the Moon; data on the power reflection coefficient could be telemetered back to earth for analysis. The feasibility of the whole system is discussed. *Subject Headings:* **1. Satellite radar techniques 2. Lunar surface 3. Lunar probes.**—*Authors' abstract.* Ⓢ

11.12–181 551.507.362.1:523.3

O zapuske kosmicheskoĭ rakety v storonu Luny (iz soobshcheniĭ Tass). [Launching of a cosmic rocket toward the Moon (from TASS announcements).] *Priroda*, Moscow, No.

1:I–IV, Jan. **1959. DLC**—On Jan. 2, 1959 the USSR launched a multistage rocket toward the Moon. The final stage of the rocket, which weighed 1,472 kg without fuel, was provided with a special container which contained instrumentation for the following investigations, viz: determination of the Moon's magnetic field, radiation intensity and variation of intensity of cosmic rays, determination of lunar radioactivity, etc. For observations on the flight of the final rocket stage it contained a radio transmitter, broadcasting on 19,997 and 19,995 mHz telegraphic messages 0.8 and 1.6 seconds long, a radio transmitter on a frequency of 19,993 mHz broadcasting scientific data, a transmitter with a frequency of 183.6 mHz used for measuring parameters of motion and broadcasting scientific data, and special apparatus for making a Na cloud. The course of the rocket and the nature of the signals transmitted for approximately 3-hour intervals from 0300 h (Moscow time) Jan. 3 to 10:00 h Jan. 5, 1959, is described. The cosmic rocket went into the periodic orbit of an artificial satellite on Jan. 7–8, 1959. *Subject Headings:* **1. Moon rockets 2. Moon's magnetic field 3. Moon's radiation intensities.** —*I.L.D.* Ⓢ

11.12–182 551.507.362.1:523.3

Lunik II—the Russian moon rocket. *Current Science*, Bangalore, 28(9):359, Sept. **1959. DWB, DLC** A short note on the successful Russian launching of the Moon rocket Lunik II, which landed on the Moon almost to the minute according to schedule. The rocket was launched on the afternoon of Saturday, Sept. 12, 1959. The final stage of the rocket hit the Moon at 00 hours, 2 minutes, 24 seconds (Moscow time) on Monday morning, Sept. 14, 1959. Launching details and the rocket radio signalings are reported. The rocket impact on the Moon as observed from different observatories is described. *Subject Headings:* **1. Moon rockets 2. Rocket radio communication.**—*I.S.* Ⓢ

11.12–183 551.507.362.2:523.3:778.3

Photographs of the Moon's hidden side from Lunik III. *Current Science*, Bangalore, 28(11):433–434, Nov. **1959.** fig. **DWB, DLC**—The first pictures of the hidden side of the Moon taken by the Russian Automatic Interplanetary Station and transmitted to earth were released for publication on Oct. 26, 1959. The photographs were taken with a two-unit camera, each unit of which had a different optical system enabling simultaneous pictures to be taken on two different scenes. The present paper discusses the photographic apparatus, techniques and the timing of the photograph. A reproduction of the picture showing the hidden side of the Moon is also printed. It is now possible to piece together the hitherto unseen lunar objects and those already known, and thereby to determine their selenographic coordinates. *Subject Headings:* **1. Satellite observation of the moon 2. Moon photographs 3. Far side of moon.**—*I.S.* Ⓢ

11.12–184 551.507.362.2:523.34:778.3

Daten der russischen Rakete Lunik III und photographische Aufnahmen der erdabgewandten Seite des Mondes. [Data on the Russian Moon Rocket III and photographs of the back side of the moon.] *Naturwissenschaftliche Rundschau*, Stuttgart, 12(12):466–467, Dec. **1959.** 3 figs. **DWB, DLC** The space probe, Lunik III, was released by the U.S.S.R. on Oct. 4, 1959, 0900 h, Central European time. This note contains daily flight data from Oct. 4 to Oct. 18, lists of the hitherto unknown topographic formations on the moon and of those formations visible from the earth, a diagram of the automatic interplanetary station Lunik III and photographs of the dark side of the moon. *Subject Headings:* **1. Soviet space probe 1959 Theta (Lunik III) 2. Moon rockets 3. Photographic observation techniques.** —*I.L.D.* Ⓢ

11.12–185 778.3:523.3

Hoffmeister, C., **Bilder von der unsichtbaren Seite des Mondes.** [Pictures of the invisible side of the moon.] *Die Sterne*, Leipzig, 36(3/4):49–52, March/April **1960.** 3 figs. **DLC** The article shows pictures, without retouching, obtained by radio and made available by A. A. Mikhailov, Director of the Pulkovo Observatory. The author gives some technica explanations about the employed system. The invisible side of the moon shows a very smal

number of "seas." *Subject Headings:* **1. Far side of moon 2. Lunar atmosphere 3. Lunar photographs 4. Pulkovo Observatory, USSR.**—*A.V.* Ⓢ

11.12–186 523.39

Davies, Merton E. (*Rand Corp., Santa Monica*), **How good is Lunik III photography?** *Astronautics*, N. Y., 5(5):28–29, May **1960.** figs., port., vita. **DLC**—A comparison is made between the Soviet pictures of the back side of the moon, taken from Lunik III, with the earth originated photographs of front side. The primary aim of the Soviet pictures was to record the maximum area of the unseen side without particular regard to quality. The pictures show that the back side of the moon is more monotonous than the front side. According to the Soviet pictures, the image of the moon differs appreciably from a circle. Next step will be to acquire pictures of better resolution. These will be of great scientific importance. *Subject Headings:* **1. Moon's far side 2. Lunar photographs.**—*A.H.K.* Ⓢ

D. Earth

See also: **Terrestrial ether drift experiment** (Ruderfer), 11.12–5; **Equatorial acceleration and form of continents** (Schoenberg), 11.12–166; **The IGY** (Brunt), 11.12 192; **Satellite orbits** (Section C7b), 11.12–537 to 11.12–555; **Determination of gravitational field** (O'Keefe), 11.12–578.

11.12–187 551.242:525.3

Pariĭskiĭ, N. N., **O vliianii zemnykh prilivov na vekovoe zamedlenie vrashcheniia Zemli.** [The influence of earth tides on the secular retardation of the Earth's rotation.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):543–549, May/June **1960.** table, 18 refs., 12 eqs. Russian and English summaries p. 543. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3), **1960. DLC**—Recent results of determination of the phase lag of earth tides, obtained from long observations of tidal variations of gravity, relative to theoretical data for an ideal elastic Earth show that there is a small lag of the order of 1°–4°. A more precise determination demands the elaboration of the theory of secondary effects of sea tides and a detailed investigation of instrumental time-lag. A new method of accounting for the influence of this lag on the secular retardation of the Earth's rotation is given. For this method data on the internal structure of the Earth are not necessary, the observed value of Love's constant K being used. It is shown that rigid tides can contribute essentially to the effect of secular retardation of the Earth's rotation. So, adopting the values of secular accelerations of the Moon and Sun according to Spencer Jones, and accounting for the additional acceleration of the Earth's rotation, due to internal causes the total effect of the secular retardation of the Earth's rotation corresponds to a lag of diurnal tidal waves equal to 2.°1 and of semidiurnal −4.°2. *Subject Headings:* **1. Earth tides 2. Rotation of the earth.**—*Author's abstract.* Ⓢ

11.12–188 525.14:526.15

Arnold, Kurt (*Geod. Inst. Akad. Wissenschaften, Berlin, Potsdam Telegrafenberg*), **Vergleiche zwischen verschiedenen Definitionen des mittleren Erdellipsoids.** [Comparison between various definitions of the middle earth ellipsoid.] *Beiträge zur Geophysik*, Leipzig, 68(3):129–136, **1959.** 9 refs., 7 eqs. German and English summaries, p. 129. **DWB, DLC**—A comparison between the two usual definitions of the best fitting earth-ellipsoid: the definition in the sense of Helmert that refers to the best approximation to the geoid, and the definition concerning the normal spheroid, shows that both definitions are equivalent if the uncertainty of the observations is neglected. *Subject Heading:* **1. Earth figure.**—*Author's abstract.* Ⓢ

11.12–189 551.507.362.2:526.17

O'Keefe, J. A.; Eckels, Ann and Squires, R. K. (*all, Theoretical Div., Nat'l. Aeronautics and Space Admin., Wash., D. C.*), **Vanguard measurements give pear-shaped component of earth's figure.** *Science*, 129(3348):565–566, Feb. 27, **1959.** fig., 5 refs., 2 eqs. Also: **Comment** by J. L. Brenner; R. Fulton and N. Sherman in article Symmetry of the Earth's figure. *American Rocket Society, Journal*, 30:278–279, **1960.** Reply to the latter article by Charles A.

Whitney in *Smithsonian Institution. Astrophysical Observatory, Special Report*, No. 46, July 11, 1960. p. 5–6. **DLC**—The determination of the Vanguard satellite, 1958 B_2, has revealed the existence of periodic variations in the eccentricity of that satellite. Methodologically based on an equation developed by O'Keefe and Batchlor, a hypothesis is put forward. The calculations indicate that the periodic changes in eccentricity can be explained by the presence of a third zonal harmonic which modifies the geoid toward the shape of a pear. In the present case, the stem of the pear is up that is, at the north pole. According to the analysis, the amplitude of the third zonal harmonic is 0.0047 cm/sec² in the surface acceleration of gravity, or 15 meters of undulation in the geoid. *Subject Headings:* **1. U. S. Satellite 1958 Beta (Vanguard I) 2. Earth figure. I. Brenner, J. L. II. Fulton, R. III. Sherman, N. IV. Whitney, Charles A.**—*I.S.* Ⓢ

11.12–190 551.507.362.2:525.14

Blitzer, Leon (*Arizona Univ., Tucson and Space Laboratories, L. A., Calif.*), **Earth oblateness in terms of satellite orbital periods.** *Science*, Wash., D. C., 129(3345):329–330, Feb. 6, 1959. fig., 5 refs., 2 eqs. **DLC**—A theoretical equation relating the earth's oblateness to the anomalistic and nodical periods and orbit parameters of an earth satellite is presented. In the absence of exact data on nodical periods, Vanguard prediction data are utilized to obtain a check calculation for the oblateness and to establish the validity of the method. *Subject Headings:* **1. Satellite orbits 2. Earth figure.**—*Author's abstract.* Ⓢ

11.12–191 551.507.362.2:525.14

King-Hele, D. G. and Merson, R. H. (*both, Royal Aircraft Estab. Farnborough Hants.*), **A new value for the earth's flattening, derived from measurements of satellite orbits.** *Nature*, London, 183(4665):881–882, March 28, 1959. 4 refs. **DWB**—The new value which is based on combining the Sputnik 2 and the Vanguard 1 data gives $J=(1624.6\pm0.3)\times10^{-6}$, $D=(6\pm1)\times10^{-6}$; the corresponding value for the earth's flattening is $1/(298.20\pm0.03)$. *Subject Headings:* **1. Satellite orbits 2. Earth figure.**—*W.N.* Ⓢ

B. UPPER ATMOSPHERE

1. GENERAL

See also: **Solar-terrestrial relationships** (Section A5h), 11.12–126 to 11.12–130; **Earth's corona** (Shklovskiĭ), 11.12–172.

11.12–192 551.506.22:551.507.362

Brunt, David, **Kelvin lecture on "The International Geophysical Year, 1957–1958."** *Institution of Electrical Engineers, Journal*, 5(54):356 358, June 1959. 2 figs. **DLC**—Some of the achievements of I.G.Y. are described. The organization of the "Solar Patrol" was one of the first among these. With the help of rockets and satellites, intense belts of radiation have been discovered at heights of 700 km and 1000 km. Recent observations show that the earth is flatter than supposed so far. According to new estimates the total ice on the Earth's surface is 4.5 million cu. ft. Other discoveries include a subsurface current as powerful as the gulf stream near the equator. *Subject Heading:* **1. International Geophysical Year 1957–1958.**—*A.H.K.* Ⓢ

11.12–193 551.506.22 551.5:550.3

Termination of the International Geophysical Year. *Endeavour*, London, 18(69):3–4, Jan. 1959. **DLC**—During the IGY which ended Dec. 31, 1958, studies were made of 12 aspects of the sun and the earth, including: meteorology, seismology, oceanography, aurora and airglow and others. This report summarizes very briefly what was achieved, and stresses the importance of this scientific quest for a clear understanding of man's environment. Over 60 nations took part in the project. *Subject Heading:* **1. International Geophysical Year, 1957–1958.**—*N.N.* Ⓢ

11.12–194 551.506.22 551.5:550.3

†*International Geophysical Year, 1957/1958. IGY World Data Center A (Wash., D. C.), **Interim catalogue of data in IGY World Data Center A.** Its *IGY General Report Series*, No. 7, Nov. 30, **1959.** 169 p. almost entirely tables, 31 refs. **DWB** (500.83 I612in)—Elaborate specifications of data available 11 months after IGY ended in World Data Center A in the different disciplines: 1) airglow and ionosphere, 2) aurora (instrumental), 3) aurora (visual), 4) cosmic rays, 5) geomagnetism, gravity and seismology, 6) glaciology, 7) longitude and latitude, 8) meteorology and nuclear radiation, 9) oceanography, 10) rockets and satellites, 11) solar activity. A table shows location of centers in 14 disciplines. Data Center A is in the U. S. *Subject Headings:* **1. IGY World Data Center A 2. IGY Data Catalogs.**—*M.R.* Ⓢ

11.12–195 551.521.18(73)

Gergen, John L. and Huch, William F. (*both, School of Physics, Univ. of Minn.*), **A synoptic study of infra-red radiation over the U. S.** *Nature*, London, 186(4723):426–429, May 7, **1960.** 4 figs., ref., eq. **DWB**—The synoptic study of infrared radiation was carried out by 25 United States Weather Bureau stations during the nights of May 26–30, 1959. The observations were made by the black ball method. The conclusions from the observed results include: 1) Clouds have an overwhelming effect on the propagation of infrared radiation through the atmosphere. 2) The variation in power loss to space over a relatively small geographical region on any one night is at least as large as the variation in the mean power loss to space from equator to poles. 3) Since infrared radiation is the only mechanism by which the earth can lose to space the energy it gains from the sun, the observed power loss to space must significantly affect the formation and propagation of weather systems. It was found that the power loss to space varies from 15.6 to 26.6 MW/cm². *Subject Headings:* **1. Infrared radiation studies 2. Radiation loss to space 3. United States.**—*E.K.* Ⓢ

11.12–196 551.508.9:551.507.362.1

Nardone, Louis J., **Research directed toward the development of photooptical electronic and calibration apparatus.** Northeastern Univ., Boston. Electronics Research Lab., Contract AF 19(604)-1749, Final Technical Report, March 31, **1960.** 49 p. 23 figs. (incl. photos), 11 refs., eqs. **DWB** (M08.25 N224tec)—In support of the upper air research program, this report presents the activities conducted by the organization concerned with direct and indirect support of projects dealing with micrometeorite detection, measurement of day airglow and the installation of a data-reduction facility. Results obtained from the micrometeorite detection experiment (Feb. 5, 1959. Holloman Air Force Base, New Mexico) indicated the need of improvement in the existing system and also the need of devising new techniques. The experiment on Aug. 21, 1959 (White Sands Missile Range, New Mexico) showed a sky brightness of less than 1.08×10^{-4} cd/ft² above 175,000 feet. It was concluded that the 6300A oxygen line must have a strength of less than 0.5 kilorayleighs. A data-reduction facility was established to handle data obtained primarily from fm-fm telemetry system. The equipment development program includes a magnetic beam-switching tube counter, an improved facsimile recorder, a telemetry subcarrier separator, a rocket-borne, low-frequency, solar-noise receiver. *Subject Headings:* **1. Rocket instrumentation 2. Upper atmosphere instruments.**—*E.K.* Ⓢ

2. COSMIC RADIATION

A. General

See also: **Antiparticles in space** (Hones), 11.12–1; **Literature for 1957,** 11.12–7; **Low-energy X-rays from interplanetary space** (Reiffel), 11.12–168; **Van Allen radiation belts** (Section B3), 11.12–267 to 11.12–292.

11.12–197 551.506.22:551.521.64

Haymes, Robert C. (*Dept. of Physics, N. Y. U.*), **The world-wide IGY Cosmic Ray Program.** *New York Academy of Sciences, Transactions*, Ser. 2, 22(2):96–103, Dec. **1959.** 8 figs. **DLC**—The Cosmic Ray Program during IGY, coinciding with the period of maximum solar activity, its organization, tasks and some of its early results are described. The U. S. Cosmic Ray Technical Panel was in charge of the measurements of the intensity. The neutron

monitor and the meson telescope recorded the data every 15 min, and during a solar flare even more frequently. In addition to the World Data Centers, the University of Minnesota was selected to analyze the data. The research at high altitudes was conducted by balloons, rockets and satellites. The Van Allen radiation, Forbush decreases and X-ray bursts are described as preliminary results. The author's own work, at the Department of Physics, New York University, revealed a sudden doubling of the neutron intensity at balloon altitudes just before sunset. Illustrations include maps showing the location of World Data centers and an organization chart. *Subject Heading:* **1. IGY cosmic ray program.**—*O.T.* Ⓢ

11.12–198 551.521.64:061.3(473)

Daniel, R. R.; Menon, M. G. K. and Sreekantan, B. V. (*all, Tata Inst. of Fundamental Res., Bombay*), **International Conference on Cosmic Ray Physics, Moscow 1959.** *Current Science*, Bangalore, 28(10):389–391, Oct. **1959. DWB, DLC**—A report on the Cosmic Ray Conference held in Moscow, July 6–11, 1959. International Union of Pure and Applied Physics sponsored the Conference. 250 scientists from 25 countries participated. The Russian scientists numbered 175. Some 175 original papers were read covering in general the following subjects: 1. Nuclear interaction at high energies 2. Extensive air showers 3. Experiments on the primary radiation using balloons, rockets, and satellites 4. Cosmic ray intensity variations and 5. Origin of cosmic rays and related astrophysical aspects. This report summarizes the points brought out in the papers in these areas. *Subject Headings:* **1. Cosmic ray conferences 2. Moscow, U.S.S.R.**—*I.S.* Ⓢ

11.12–199 551.521.64:061.3(82)

Korff, Serge A. and Chasson, Robert L., **Bariloche cosmic-ray conference.** *Physics Today*, N. Y., 12(7):32–33, July **1959.** 2 photos. **DWB**—In February 1959, a cosmic ray conference was held at San Carlos de Bariloche, Argentina. The principal topics discussed were cosmic-ray time variations and their possible relationships to solar and geophysical phenomena in general. Also considerable discussion of corrections to be applied to long-term neutron and meson monitor records in order to permit the most effective use of worldwide IGY data. H. Elliot of Imperial College, London gave an extensive review of some recent calculations (Quenby and Webber) of the behavior of cosmic ray particles in the geomagnetic field. *Subject Headings:* **1. Cosmic ray conferences 2. San Carlos de Bariloche, Argentina.** —*E.Z.S.* Ⓢ

11.12–200 551.521.64:061.6(68,5–011)

Korff, Serge A. (*N. Y. Univ., College of Engineering*), **Cosmic ray research facilities in Africa and the Orient.** *Physics Today*, N. Y., 12(12):46–47, Dec. **1959.** 2 photos. **DLC**—In Africa research is being done at Hermanus, South Africa, U. of Stellenbosch, Capetown, S. Africa and Mekere College, Kampala, Uganda. In the Orient, Univ. of Colombo, Ceylon, Institute of Nuclear Study, Univ. of Tokyo, Mt. Novikura Lab., Japan and Univ. of Taipei, Taiwan, are doing the research. Photographs are included. *Subject Headings:* **1. Cosmic ray research 2. Africa 3. Far East.**—*A.H.K.* Ⓢ

B. Instruments

See also: **Attempt to detect energetic gamma radiation** (Danielson), 11.12–246; **Cloud chamber study of air showers** (Gémesy et al.), 11.12–258; **Cloud chamber study of penetrating showers** (Higashi et al.), 11.12–260; **Star production** (Yagoda), 11.12–291.

11.12–201 551.521.64:535.33.018

Bennett, H. W. (*College of Adv. Tech., Loughborough*) and Nash, W. F. (*Univ. of Nottingham*), **Model experiments on the design of solid iron magnets for use in cosmic ray spectrographs.** *Nuovo Cimento*, Bologna, Supplement No. 2 to Ser. 10, Vol. 15, **1960.** p. 193–201. 7 figs. **DLC**—The high magnetic field available in a magnetized block of iron may be used to measure the momentum of non-interacting particles such as μ-mesons, provided that the line integral of the magnetic induction is known with sufficient accuracy. Model "picture frame" magnets were constructed in order to investigate the effects of geometry and of degree

of magnetization on the uniformity of the magnetic induction. The relative merits of passing the particles through the energizing coils or the open ends are considered. It is found that high inductions, with uniformity of ±3%, may easily be obtained over 90% of the available volume for comparatively low power dissipation. *Subject Heading:* **1. Cosmic ray spectrographs.**—*Authors' abstract.* Ⓢ

11.12–202 551.508.25:551.521.64

Mistry, N. B.; Murthy, G. T.; Ramana Murthy, P. V. et al., (*all, Tata Inst. Fund. Res., Bombay*), **Triggered spark counter arrays of large area (square meters) for experiments on very high energy cosmic ray particles.** *Il Nuovo Cimento*, Bologna, Ser. 10, 17(3):429–437, Aug. 1, **1960.** 3 figs., 3 plates, table, 4 foot refs. Italian summary p. 437. **DLC**—The constructional and operational features of triggered spark counters of large area are described. These counters are being used in conjunction with nuclear emulsions in current experiments in this laboratory on high energy nuclear interacting particles which arrive simultaneously over large areas, sometimes associated and at other times unassociated with air showers. For these experiments the spark counters and emulsions are being used in arrays covering an area of a few square meters. *Subject Headings:* **1. Cosmic ray instruments. I. Sreekantan, B. V.**—*Authors' abstract.* Ⓢ

11.12–203 551.521.64:535.33.018

O'Connor, P. V. and Wolfendale, A. W. (*both, Durham College, Univ. of Durham*), **The characteristics of a solid iron magnet for use in a cosmic ray spectrograph.** *Nuovo Cimento*, Bologna, Supplement No. 2 to ser. 10, Vol. 15, **1960.** p. 202–210. 8 figs., table. **DLC**—Many advantages are gained by deflecting weakly interacting cosmic rays in magnetized iron instead of the conventional air gap of an electromagnet. A solid iron magnet has been constructed in the form of a rectangular transformer core with excitation windings on opposite sides of the core. The design is based on the results of model experiments by Bennett and Nash on the variation of induction throughout the iron and the leakage field above and below the magnet. When the magnet is operated at a power of 2 kW (mean $\int B\,dl = 982$ kG cm), the variation of integrated magnetic induction for vertical particle trajectories is less than ±3%. *Subject Heading:* **1. Cosmic ray spectrographs.**—*Authors' abstract.* Ⓢ

11.12–204 551.501.7:551.593.12:551.521.64

Yagoda, Herman (*Air Force Res. Center, Bedford, Mass.*), **Cosmic ray detection by visual scintillations.** (In: Institute of the Aeronautical Sciences, **Applications of manned stratospheric laboratories. 1959.** p. 113–124. 4 figs., foot refs.) **DWB** (M(051) V847ap)—A discussion of the visual detection technique to study the individual scintillation response produced by the various components of cosmic radiation. The intensity of cosmic radiation becomes appreciable at high elevations and the pilots of manned stratosphere balloons can study the nature of the light produced by very densely ionizing particles. The preliminary experiments carried out in this connection are reported. The paper is nicely illustrated by photographs. *Subject Headings:* **1. Cosmic ray detection 2. Scintillation observation techniques 3. Cosmic ray ionization.**—*I.S.* Ⓢ

c. Rocket and Satellite Measurements

See also: **Magnetic cutoff rigidities of charged particles** (Rothwell), 11.12–253; **Van Allen radiation belts** (Section B3), 11.12–267 to 11.12–292; **Rockets and astronomical problems** (Kukarkin), 11.12–510; **Scientific problems in cislunar space** (Singer), 11.12–520.

11.12–205 551.507.362.2:551.521.64

Powell, C. F. (*Univ. of Bristol*), **Experiments on cosmic radiation by means of artificial satellites.** *Royal Society of London, Proceedings, Ser. A*, 253(1275):482–487, Dec. 29, **1959. DWB, DLC**—The paper presents some problems of the cosmic ray radiation research to which an adequate satellite program would make a valuable contribution. The satellite could provide means for 1) the observation of nucleon-nucleon collisions in the region of extremely

high energies, 2) investigation of the origin of cosmic rays, and 3) detection of X-ray radiation. *Subject Heading:* **1. Satellite cosmic ray observation techniques.**—*E.K.* Ⓢ

11.12–206 551.507.362.2:551.521.64:537.56

Rosen, A.; Coleman, P. J., Jr. and Sonett, C. P. (*all, Space Technology Lab., Los Angeles, Calif.*), **Ionizing radiation detected by Pioneer II.** *Planetary and Space Science*, N. Y., 1(4): 343–346, Sept. **1959.** 2 figs., 3 refs., eqs. **DWB, DLC**—The total ionizing component of cosmic radiation was measured up to an altitude of 1550 km. An upper bound to the ratio of average-to-minimum specific ionization was determined by comparing the ionization with the count-rate observations from the Explorer IV satellite. This result implied that protons are the predominant species which gave rise to the observed ionization. *Subject Headings:* **1. U. S. Space probe Pioneer II 2. Satellite cosmic ray data 3. Cosmic ray ionization.**—*Authors' abstract.* Ⓢ

D. Origin

See also: **Crab and Cygnus A as gamma ray sources** (Savedoff), **11.12 70; Search for gamma radiation from Cygnus A** (Braccesi et al.), **11.12–71.**

11.12–207 551.521.64:537.591.2 523.16

Cocconi, Giuseppe (*Cornell Univ., Ithaca, N. Y.*), **Origin of the cosmic radiation.** *Astrophysical Journal, Suppl. Ser.*, Chicago, 4(44):417–422, June **1960.** fig., 13 refs., eq. **DLC**—Cosmic rays are created in turbulent plasmas present in practically all astronomical objects. Their diffusion in space is governed by their transport mean-free path, which increases as the cosmic-ray energy increases. On the earth the small energy cosmic rays are mostly contributed by stars present in the region of the spiral arm where the earth is located. The moderate energy ones come mostly from novae and from supernovae near the center of the galaxy. The most energetic rays arrive from other galaxies and from the intergalactic spaces. The data on the mass spectrum, the energy spectrum, and the angular distribution of the cosmic rays arriving on earth are consistent with this picture. A graph shows the energy density in galactic space. *Subject Headings:* **1. Cosmic ray origin 2. Cosmic ray spectrum.**—*E.Z.S.* Ⓢ

11.12–208 523.165

Davis, L., Jr. (*Calif. Inst. of Tech., Pasadena, Calif.*), **The origin of cosmic rays.** *Nuovo Cimento*, Bologna, Supplement No. 1 to Ser. 10, Vol. 13, **1959.** p. 324–329. eqs. **DLC**—Primary cosmic rays, i.e. those outside the solar system, are discussed. Energy density, isotropy, distribution over the elements and energy spectrum as properties of cosmic rays are summarized. A brief discussion of acceleration mechanisms is presented. Some implications of properties of cosmic rays point to the galactic system. The storage of cosmic radiation is analyzed. The applicability of the Fermi mechanism is ascertained. The possibility of storage for 10^6 years is found possible. Assumption of acceleration in a limited subregion out of which there is a rapid diffusion is consistent with the Fermi mechanism. Conditions for an appropriate model are suggested. *Subject Headings:* **1. Cosmic ray origin 2. Primary cosmic rays.**—*O.T.* Ⓢ

11.12–209 523.164.42:523.855:523.165

Peters, B. (*Tata Inst. of Fundamental Research, Bombay*), **Origin of cosmic radiation.** *Nuovo Cimento*, Bologna, Supplement No. 2 to Ser. 10, Vol. 14, **1959.** p. 436–456. 16 refs., eqs. **DLC**—Based on a theory developed by Shklovskiĭ and Ginsburg an attempt is presented for an interpretation of the intensity frequency spectrum and polarization of the optical and radio emission from the remnants of super nova explosions; the properties of radio emission from other parts of the galaxy and the intensity, energy spectrum and composition of the primary cosmic radiation. The origin of radio noise, the nuclear component of cosmic radiation, the primary cosmic radiation observed near the Earth, the chemical composition of nuclear primary radiation and its history of motion, cosmic ray nuclei and electrons in the galactic halo, the energy requirement, the diffusion of cosmic ray nuclei in the galaxy, conditions at the galactic boundary and cosmic ray nuclei in supernova envelopes are investigated and

analyzed. Problems are suggested. *Subject Headings:* **1. Cosmic ray origin 2. Primary cosmic radiation 3. Radio emission from galaxy.**—*O.T.* Ⓢ

11.12–210 551.521.64

Powell, Cecil F. (*Bristol*), **Die Entstehung der kosmischen Strahlungsteilchen hoher Energie.** [Origin of high-energy cosmic radiation particles.] *Naturwissenschaftliche Rundschau*, Stuttgart, 12(12):447–453, Dec. **1959.** 4 figs. **DWB, DLC**—The author presents a non-technical account of present knowledge on the origin of cosmic radiation particles of high energy. The discussion includes the following, viz: the importance of primary cosmic radiation because of its extremely high energy and its value in cosmological studies; the nature of cosmic radiation including the charge spectrum of cosmic radiation, comparative frequency of the elements in primary cosmic radiation, origin of the light elements and explanation of the presence of nickel and iron; source and history of cosmic radiation including the possible origin on the supernovae, isotropic character of the cosmic radiation entering into the solar system and the presence of lithium, berylium and boron which are absent in super novae, the galactic origin of cosmic radiation and the possible age of cosmic radiation. *Subject Headings:* **1. Cosmic ray origin 2. Chemical composition of cosmic rays.**—*I.L.D.* Ⓢ

11.12–211 537.59

Singer, S. Fred (*Univ. of Maryland, College Park, Md.*), **On the origin of the charge spectrum of the primary cosmic radiation.** *Nuovo Cimento*, Bologna, Supplement No. 1 to Ser. 10, Vol. 12, **1959.** p. 120–121. table, 13 refs. **DLC**—As amendment to the previous publication a table is presented showing data on cosmic abundances, including the primary cosmic radiation beyond $Z=10$ and a list of supplementary references. *Subject Headings:* **1. Primary cosmic rays 2. Cosmic ray spectrum.**—*O.T.* Ⓢ

e. Distribution, Variations

See also: **Solar flare connected with increase of cosmic radiation** (Křivský et al.), 11.12–102; **Extension of solar corona into interplanetary space** (Parker), 11.12–169.

11.12–212 550.38:551.521.64

Bachelet, F.; Balata, P.; Conforto, A. M. et al., **Cosmic ray and geomagnetic disturbances from July 1957 to July 1958, Pt. 1, The cosmic ray events and their correlation with the geomagnetic events.** *Il Nuovo Cimento*, Bologna, Ser. 10, 16(2):292 319, April 16, **1960.** 11 figs., 3 tables, 25 foot refs. Italian summary p. 319. **Pt. 2, The geomagnetic events.** *Ibid.*, 320–331. fig., 2 tables, 2 foot refs. Italian summary p. 331. **DLC**—In Pt. 1, Cosmic Ray Storms (CRS), i.e. world-wide decreases of the C. R. intensity as measured by standard neutron monitors in Rome and in other parts of the world, were systematically investigated during the period July 1957–July 1958, in correspondence with Magnetic Storms (MS). The correlations CRS→MS and MS→CRS were examined. The characteristic features of both classes of events were considered in order to find out which of them were preferential for the association itself. Some aspects of the correlation were approached by statistical method. In Pt. 2 the MS which occurred in the period July 1957–July 1958 are selected and classified in view of an analysis of their correlation with CRS. The methods and the criteria employed are described in detail. A list of all geomagnetic events thus identified is given. *Subject Headings:* **1. Geomagnetic effects on cosmic rays 2. Cosmic ray storms. I. Marini, G.**—*Authors' abstract.* Ⓢ

11.12–213 537.5 551.521.64

Fan, C. Y.; Meyer, P. and Simpson, J. A. (*all, Enrico Fermi Inst. for Nuclear Studies, Univ. of Chicago*), **Cosmic radiation intensity decreases observed at the earth and in the nearby planetary medium.** *Physical Review Letters*, N. Y., 4(8):421–423, April 15, **1960.** 2 figs., 8 refs. **DLC**—This note reports preliminary experiments which prove that existing theories for the modulation mechanism responsible for rapid decreases of primary cosmic-ray intensity cannot invoke the presence of the Earth or its magnetic field. A figure shows the cosmic-radiation intensity as a function of time, showing on Aug. 20, 1959 a Forbush-type intensity

decrease of 15% within five hours. Another shows the relative changes in cosmic-ray intensity at the satellite and at the earth for the sharp intensity decrease of Aug. 20. Authors used a cosmic-ray detector carried by Explorer VI satellite launched Aug. 7, 1959. The continuous record of the neutron intensity monitor at Climax, Colorado was chosen to represent the changes at the earth. *Subject Headings:* **1. Cosmic ray decreases 2. Cosmic ray theories 3. Satellite cosmic ray data.**—*E.Z.S.* Ⓢ

11.12–214 551.521.64

Fenton, A. G.; McCracken, K. G. (*both, Univ. Hobart, Tasmania*); Rose, D. C. and Wilson, B. G. (*Nat'l. Res. Coun. Banff, Alberta*), **The onset times of Forbush-type cosmic ray intensity decreases.** *Canadian Journal of Physics*, Ottawa, 37(9):970–982, Sept. **1959.** 6 figs., 3 tables, 10 refs. **DWB, DLC**—The onset times of a number of Forbush-type decreases observed at four widely spaced stations are compared, and it is shown that appreciable differences occur. The stations selected were Hobart, Mawson, Ottawa, and Sulphur Mountain. It was found that a consistent pattern is obtained for the events studied when the onset times are plotted as a function of the direction of maximum sensitivity of the recorders relative to the earth-sun line. This is interpreted as being due to a directional anisotropy that exists in the mechanism producing the decreases, at least in the early stages. The depression occurs first for particles arriving from directions between 30° and 120° west of the earth-sun line. The relation between these observations and geomagnetic disturbances and the quiet-day daily variation is discussed. *Subject Headings:* **1. Cosmic ray decreases 2. Cosmic ray onset times.**—*Authors' abstract.* Ⓢ

11.12–215 551.521.64:539.18

Fotino, Mircea (*Dept. of Physics, Univ. of Calif., Berkeley*), **Low-energy π mesons in the cosmic radiation.** *Physical Review*, N. Y., 117(1):243–246, Jan. 1, **1960.** 3 figs., 5 tables, 13 foot-refs. **DWB**—The intensity of π mesons in the atmosphere is investigated in the energy region $E \lesssim_{\text{kin}} 50$ Mev at sea level and at mountain altitudes. Positive π mesons coming to rest in an absorber-scintillator are identified by the characteristic $\pi - \mu$ decay. They are detected electronically and recorded photographically. The value 1.45 ± 0.09 is adopted for the negative-to-positive ratio at small energies. The omnidirectional intensities $J\pi+$ of slow positive π mesons at sea level (91 m), Echo Lake, Colorado (3260 m), and Mt. Evans, Colorado (4310 m) are found to be 0.0094 ± 0.0024, 0.098 ± 0.005, and 0.240 ± 0.011 g^{-1} day^{-1}, respectively. The altitude dependence of $J\pi\pm$, $J_\mu\pm$ and $J\pi\pm/J_\mu\pm$ is given and the attenuation length of slow π mesons in the atmosphere found to be $L_a\pi \approx 120$–130 g/cm² in this altitude interval. A discussion covering most of the available results along the same line is presented. *Subject Headings:* **1. Cosmic ray altitude dependence 2. Meson intensities.**—*Author's abstract.* Ⓢ

11.12–216 551.521.64

Kellermann, E. W. and Islam, M. S. (*both, Dept. Physics, Univ. Leeds*), **On the anisotropy of the cosmic radiation.** *Il Nuovo Cimento*, Bologna, Ser. 10, 17(3):334–342, Aug. 1, **1960.** 5 figs., 2 tables, 7 refs., 3 eqs. Italian summary p. 342. **DLC**—An attempt has been made to reproduce some results of McCusker and his co-workers who had reported diurnal effects of cosmic ray showers. The design of the apparatus follows closely that of these workers, but allows more detailed information about each recorded event to be obtained. The main categories of observed events, including those examined by McCusker et al., show no significant diurnal variation. A possible sidereal diurnal variation of a particular group of events is critically examined, and it is concluded that, in spite of strong statistical weight, the implications of accepting the variation as physically real do not at present allow it to be regarded as such. *Subject Headings:* **1. Diurnal cosmic ray variations 2. Cosmic ray showers.**—*Authors' abstract.* Ⓢ

11.12–217 551.506.22:551.521.64

Kodama, Masahiro and Wada, Masami (*both, Inst. of Physical & Chemical Res., Tokyo*), **Intensity minimum in cosmic-ray neutrons during the International Geophysical Year.** *Journal of Geophysical Research*, Wash., D. C., 65(7):2203–2205, July **1960.** 4 figs., 2 tables, ref.

DLC—The long-term variation in cosmic-ray neutron intensity during the IGY from July 1957 to Dec. 1958 has been investigated and is described. The following have been derived: 1) the minimum month of the long-term variation in cosmic-ray neutron intensity that is separated from the original data during IGY is Jan. 1958. It may also be the minimum month in the present solar cycle. 2) The shift of the minimum month in original intensity with latitude could be explained by the combination of the long-term and the transient variations. 3) Concerning the shape of each intensity variation before and after the minimum month, the essential feature is monthly rate of the intensity variation which varies with time as well as latitude. 4) Although the procedure of deducing the long-term variation from the original intensity is an approximate one, it is acceptable. 5) The analysis shows that there is a substantial difference between the long-term and the transient variations in cosmic-ray intensity. *Subject Headings:* **1. Cosmic ray neutron intensities 2. IGY cosmic ray program.**—*E.Z.S.* Ⓢ

11.12–218 551.521.64

Lloyd, J. L. and Wolfendale, A. W. (*both, Dept. of Physics, Durham College, Univ. of Durham, Eng.*), **Large-angle scattering of fast μ mesons.** *Physical Review*, N. Y., 117(1):247–249, Jan. 1, **1960.** 2 figs., table, 6 foot-refs., eqs. **DWB**—Experiments on cosmic-ray μ mesons over the past seven years have appeared to show "anomalous" scattering. This anomaly is a small excess of large-angle scattering over that expected on current nuclear models. A recent experiment by Fukui, Kitamura, and Watase has failed to show the anomaly. In the present paper the data given by Fukui et al. are re-examined and it is shown that their experiment is inconclusive. *Subject Heading:* **1. Cosmic ray mesons.**—*Authors' abstract.* Ⓢ

11.12–219 550.383.2:551.521.64

Oguchi, Takashi (*Geophys. Inst., Univ. Tokyo*) and Kodama, Masahiro (*Inst. Phys. and Chemical Res., Tokyo*), **Difference between cosmic-ray equator and the geomagnetic dip equator.** *Nature*, London, 193(4654):103, Jan. 10, **1959.** fig., 7 refs. **DLC**—The discrepancy between the cosmic-ray and dip equators may be because of an inaccurate definition of the dip equator. The validity of this assumption is illustrated by reference to specific data which consist of daily ranges of geomagnetic total intensities and of cosmic-ray intensities in the South China Sea. These data, on the assumption that the position of the dip equator is not accurately defined, show a coincidence between the cosmic ray and the geomagnetic dip equators. The opposite assumption that the geomagnetic dip equator is accurate is also considered. *Subject Headings:* **1. Cosmic ray—geomagnetic relationships 2. Magnetic dip.**—*I.S.* Ⓢ

11.12–220 551.521.64:551.2

Sándor, T.; Somogyi, A. and Telbisz, F. (*all, Inst. Physics, Cosmic Ray Lab., Budapest*), **Meteorological coefficients and solar daily variation of the cosmic radiation measured underground.** *Il Nuovo Cimento*, Bologna, Ser. 10, 17(1):1–7, July 1, **1960.** 4 figs., 2 tables, 4 foot refs., 3 eqs. Italian summary p. 7. **DLC**—The intensity of the penetrating component of cosmic radiation has been recorded since Feb. 20, 1958. The absorption and decay coefficients as well as the total barometric coefficient were determined from the data of the first year of observation. The amplitude of the fluctuation of primary radiation for each month and the amplitude of the solar daily variation are determined. *Subject Headings:* **1. Cosmic ray ground penetration 2. Underground cosmic ray variations 3. Diurnal cosmic ray variations.**—*Authors' abstract.* Ⓢ

11.12–221 523.165:551.521.64

Sandström, A. E.; Dyring, E. and Lindgren, S. (*all, Institute of Physics, University of Uppsala*), **Dependence on latitude of the amplitude of the diurnal variation of cosmic rays.** *Nature*, London, 187(4743):1099–1100, Sept. 24, **1960.** fig., 8 refs. **DLC**—A study has been made of the relative magnitude of the amplitude in different directions of the solar diurnal variation of cosmic-ray intensity using directional counter telescopes at Uppsala, Murchison Bay in the Arctic and Kiruna. The results show that the amplitude of the diurnal variation decreases with increasing angle between the asymptotic direction of the primaries and the

equatorial plane of the earth. *Subject Headings:* **1. Diurnal cosmic ray variations 2. Latitude effects on cosmic rays.**—*R.B.* Ⓢ

11.12–222 551.521.64

Sarabhai, V. (*Physical Res. Lab., Ahmedabad, India*) and Palmeira, R. (*Lab. for Nuclear Sci., M. I. T.*), **North-south anisotropy and anticipatory increase of intensity associated with the cosmic-ray storm of Feb. 11, 1958.** *Nature*, London, 184(4694):1204–1207, Oct. 17, 1959. fig., 2 tables, 7 refs. **DWB**—A discussion of the plausible mechanism of the cosmic-ray storm of Feb. 11, 1958. A summary of the important events observed on the sun and on the earth in chronological order is tabulated. The effect in cosmic rays has been examined from data of the high counting rate meson detector at the Massachusetts Institute of Technology and from a grid of neutron monitor stations. Particulars of cosmic-ray neutron monitor stations used in analysis are tabulated. A graphical illustration is presented showing the percentage deviations in the bi-hourly counting rates of the neutron monitors during successive bi-hourly periods in U. T. from Feb. 9–12. Following a discussion, it is concluded that in the two increases and the main decreases observed with the cosmic-ray storm of Feb. 11, 1958, three types of modulation process are at work. These are explained. *Subject Heading:* **1. Cosmic ray storm, Feb. 11, 1958.**—*I.S.* Ⓢ

11.12–223 551.506.22:551.521.64:517.512.2

Schwachheim, Georges (*Centro Brasileiro Pesquisas Fisicas, Rio de Janeiro, Brazil*), **The solar daily variation of the cosmic radiation: world-wide neutron monitor observations during the International Geophysical Year.** *Journal of Geophysical Research*, Wash., D. C., 65(10): 3149–3157, Oct. 1960. 7 figs., 3 tables, 8 refs. **DLC**—An analysis is given of the quiescent solar daily variation of the cosmic radiation, as recorded by neutron monitors during the International Geophysical Year. The amplitude of the first harmonic as a function of latitude shows a decrease at polar regions but is otherwise constant at 0.3 per cent. The time of maximum increases from 13 to 17 hours local time from the equator to the pole. The amplitude of the second harmonic is 0.06 per cent, and its time of maximum is 1 hour local time. The world-wide correlation of the results is also examined. *Subject Headings:* **1. IGY cosmic ray program 2. Diurnal cosmic ray variations 3. Latitude effects on cosmic rays.**—*Author's abstract.* Ⓢ

11.12–224 551.521.64

Wilson, B. G.; Rose, D. C. and Pomerantz, Martin A., **The unusual cosmic ray events of July 17–18, 1959.** *Canadian Journal of Physics*, Ottawa, 38(2):328 331, Feb. 1960. 3 figs., table, 2 refs. **DWB, DLC** –On July 17th and 18th unusual intensity changes in cosmic rays were noted. Differences in the intensity changes with different geographical positions and altitudes are apparent in the five Canadian stations and at Thule where continuous measurements have been undertaken. These stations form a net roughly triangular in shape covering geomagnetic latitudes from 57° to 88° and geographic west longitudes from 68.8° to 115.6°. In this note the data from these stations are studied and graphically represented. *Subject Heading:* **1. Cosmic ray variations.**—*I.S.* Ⓢ

11.12–225 551.521.64

Yoshida, Sekiko (*Phys. Inst., Nagoya Univ., Nagoya*) and Wada, Masami (*Inst. Phys. Chem. Res. Tokyo*), **Storm-time increase of cosmic-ray intensity.** *Nature*, London, 183(4658): 381–383, Feb. 7, 1959. 3 figs., table. **DLC**—A description of two typical intensity increases of cosmic rays by a few percent during September 13, 1957 and February 11, 1958 respectively is given. Several charts for various stations with different geomagnetic latitudes and geographical longitudes are included to illustrate worldwide variations of cosmic ray intensities and the qualitative relation between any increase or decrease in the intensity. In general the intensities increase abruptly by 2 or 3 percent on a world-wide scale regardless of diurnal variations. Variations of horizontal magnetic force at Kakioka and the international magnetic index are also plotted. Cosmic ray increases are found to coincide with the severest phase of magnetic storms. *Subject Headings:* **1. Cosmic ray increases 2. Geomagnetic storm effects on cosmic rays.**—*N.N.* Ⓢ

11.12–226 551.521.64

Mathews, P. M. (*National Res. Coun. Postdoctorate Fellow*), **Atmospheric effects on cosmic ray intensity at sea level.** *Canadian Journal of Physics*, Ottawa, 37(2):85–101, Feb. 1959. 9 figs., 2 tables, 9 refs., 12 eqs. **DWB, DLC**—Cosmic ray intensity variations of primary origin and those caused by meteorological changes appear superposed in records obtained from meson counter telescopes and neutron monitors at sea level. The study of either of these types of variation is thus greatly complicated by the presence of the other. In the present work, for the first time, the step was taken of processing the raw data to eliminate primary variations (and the inherent statistical fluctuations) so as to make possible a direct comparison of the remaining variations with the changes in atmospheric variables over the same period. The subsequent analysis confirms the expectation that there are no appreciable atmospheric effects on the intensity of the nucleonic component beyond the well-known effect associated with the sea level barometric pressure B. But in the meson case there is strong evidence that the widely used set of variables H_{100}, T_{100} (the height and temperature of the 100-mb level) and B is not very suitable for representing atmospheric effects; it seems essential to include a variable representing temperatures in the lower part of the atmosphere, and the set of variables T_{800} (temperature of the 800-mb layer), H_{100}, and B, with coefficients $k_T = -.082 \pm .008\%/°C$, $k_H = -3.04 \pm .61\%/km$, and $k_B = -.134 \pm .004\%/mb$ appears to be the best. The theoretical formula of Dorman (1957), with a barometric coefficient $\beta = -.147 \pm .004\%/mb$ and with the term representing the "temperature effect" reduced by a factor $.76 \pm .03$, gives slightly better results. However, the improvement, at least in the case of the data analyzed, is too small to justify the great labor involved in using this formula. *Subject Headings:* **1. Cosmic ray variations at sea level 2. Atmospheric effects on cosmic rays.**—*Author's abstract.* Ⓢ

F. Primary Radiation

11.12–227 537.5 551.521.64

Elliot, H. (*Imperial College of Science & Tech., London*), **Cosmic ray intensity in interplanetary space.** *Nature*, London, 186(4721):299–300, April 23, 1960. fig., table, 3 refs., eq. **DWB**—The primary cosmic ray intensity at the Earth shows characteristic variations in time which are related to solar and geomagnetic activity. Detailed study of these variations in intensity has led to the development of several alternative models of the interplanetary magnetic field. The models are briefly discussed. Space probes should make measurements which would provide a crucial check on the validity of the interplanetary magnetic field models. Direct measurements of the magnetic fields is also likely. *Subject Headings:* **1. Cosmic ray intensity variations 2. Primary cosmic ray intensities.**—*E.Z.S.* Ⓢ

11.12–228 537.5:539.17

†Engler, A.; Kaplon, M. F. and Klarmann, J. (*all, Dept. Physics and Astronomy, Univ. Rochester, N. Y.*), **Some considerations on the analysis of primary cosmic ray intensity experiments.** *Nuovo Cimento*, Bologna, Ser. 10, 12(4):310–326, May 16, 1959. fig., 22 refs., 14 eqs. English summary, p. 310; Italian summary, p. 326. **DLC**—A discussion is given of the procedures employed in the analysis of primary cosmic ray intensity experiments and the assumptions inherent in their use, with particular emphasis on nuclear emulsion as a detector. Explicit formulae for extrapolation of particle intensities for various geometries employed in emulsion work are given. Some discussion of geomagnetic effects is given and data are presented showing that the earth's shadow cone is not appreciably present at a geomagnetic latitude of 40°. *Subject Headings:* **1. Primary cosmic ray intensities 2. Nuclear emulsions.**—*Authors' abstract.* Ⓢ

11.12–229 551.521.64

Garelli, C. M.; Quassiati, B. and Vigone, M. (*all, Istituto di Fisica, Univ. Torino*), **On the relative abundances of cosmic ray nuclei of charge $Z \geqslant 3$.** *Il Nuovo Cimento*, Bologna, Ser. 10, 15(1):121–129, Jan. 1, 1960. 4 figs., table, 12 foot refs. Italian summary p. 129. **DLC**—The charge spectrum of heavy primaries ($Z \geqslant 3$) of cosmic radiation has been measured in nuclear emulsion exposed in a high altitude balloon flight at a residual atmospheric thickness of about 6 g/cm². The fluxes of light, medium and heavy nuclei at the top of the atmosphere,

and also the relative abundances of charges between $Z=3$ and $Z=14$, are given. *Subject Headings:* **1. Cosmic ray nucleon distribution 2. Heavy nuclei in cosmic radiation 3. Primary cosmic rays.**—*Authors' abstract.* Ⓢ

11.12–230 523.16:550.385 551.521.6

Gold, Thomas (*Harvard College Obs.*), **Energetic particle fluxes in the solar system and near the earth.** *Astrophysical Journal, Suppl. Ser.*, Chicago, 4(44):406–416, June 1960. 5 figs., 9 refs. **DLC**—Two modes of propagation of high-energy particles can move quickly along all the orbits that are accessible to them in the existing field. Another and much slower mode of propagation: in which the cosmic-ray particles gain access to new regions of space only at the speed at which magnetic fields are convected around by the motion of ordinary gas masses. A figure illustrates suggested shapes of magnetic field lines resulting from a chromospheric outburst. Curves show the large decrease of signal strength in high-latitude ionospheric scatter and cosmic noise receiver during the event of Feb. 23, 1956. A set of curves shows ionospheric scatter records, showing the occurrence of a flare of importance 3+ and a sudden commencement of a magnetic storm nearly coincident with a Forbush decrease as well as the enhanced ionospheric absorption. The Van Allen flux as recorded in Pioneer II with a Geiger counter is shown. *Subject Headings:* **1. High energy particles 2. Magnetic field variations 3. Van Allen belts 4. Cosmic ray increase, Feb. 23, 1956.**—*E.Z.S.* Ⓢ

11.12–231 551.521.64:551.543.

Katzman, J. and Venkatesan, D., **A world-wide study of the daily variation of the nucleonic component of cosmic rays.** *Canadian Journal of Physics*, Ottawa, 38(8):1011–1026, Aug. 1960. 8 figs., 8 tables, 7 refs. **DWB, DLC**—The semidiurnal component of the nucleonic intensity at Ottawa, Canada, is essentially a pressure effect for the 5-year period, 1955 to 1959. The diurnal variation is composed of the component due to pressure, and a component that may be attributed to an anisotropy of the primary cosmic-ray particles. The results are confirmed by a comparative study of the data from 15 stations between the geomagnetic latitudes 83°N and 73°S. A world-wide barometric coefficient of -0.72% per mb was obtained from the semidiurnal component and this coefficient was used to correct the diurnal component at all the stations. The average corrected diurnal variation during the period of study common to all stations, August 1957 to October 1958 is 0.27% and occurs at 14 h 16 m solar time. There is considerable spread in both amplitude and phase angle amongst the various stations. The root mean square differences from the mean amplitude is $\pm 0.05\%$ and from the mean phase angle is $\pm 10°$ (40 minutes in time). The difficulty of drawing definite conclusions about the anisotropy from short-term studies of individual stations is pointed out. *Subject Headings:* **1. Nucleonic components of cosmic rays 2. Diurnal cosmic ray variations 3. Primary cosmic ray anisotropy 4. Pressure effects on cosmic rays.**—*Authors' abstract.* Ⓢ

11.12–232 551.521.6

†Kristiansson, K.; Mathiesen, O. and Waldeskog, B., **Abundance of nuclei heavier than oxygen in the primary cosmic radiation.** *Arkiv för Fysik*, Stockholm, 17(27):455–483, 1960. 13 figs., 12 tables, 45 refs., eqs. **DWB**—Photometric measurements have been made on 6 tracks of heavy primary particles ($Z>8$), which were found in an emulsion stack exposed over Texas at 41° geomagnetic latitude. The measurements have been corrected for different emulsion effects. The tracks were selected according to a track length criterion which states that the tracks to be accepted must be long enough to give a standard error in the determination of the charge not exceeding 0.30 units of charge. The charge calibration was made by δ-ray counting and by studies of break-up events. A small amount of fast but non-relativistic particles was found in the material. These particles have been identified from measurements of mean track width and rate of change of mean track width along the track. The spectrum shows well-resolved peaks. The following observations are made in the spectrum. The ratio $N(17 \leqslant Z \leqslant 26)N(9 \leqslant Z \leqslant 16) = 0.46 \pm 0.14$ at the top of the atmosphere. The abundance of odd nuclei is much less than the abundance of even nuclei. Neon, magnesium, and silicon are the most abundant elements and occur with approximately the same frequency. There are

ew primary particles in the charge region $17 \leqslant Z \leqslant 23$. There are two comparatively large particle groups, namely, chromium and iron of roughly the same size in the very heavy region. No particles heavier than iron have been found. The relative abundance of oxygen, silicon, and iron is discussed and compared with the mean universal abundance. *Subject Headings:* **. Cosmic ray spectrum 2. Primary cosmic rays 3. Heavy nuclei in cosmic radiation 4. Cosmic ray nucleon distribution 5. Photometry of cosmic ray 6. Chemical composition of cosmic rays 7. Texas, U. S.**—*Authors' abstract.* Ⓢ

11.12–233 551.521.64:535.242

Kristiansson, K.; Mathiesen, O. and Waldeskog, B., **Identification of non-relativistic heavy primaries in cosmic radiation by photometric measurements in nuclear emulsions.** *Arkiv för Fysik*, Stockholm, 17(28):485–493, **1960.** 5 figs., 8 refs., eqs. **DWB**—The possibility is discussed of determining the charge of a non-relativistic heavy primary particle by photometric measurements of mean track width (MTW) and the rate of change of mean track width along the track. The error in the charge determination is sensitive to the length of the track measured and the particle velocity. Correct identification is possible as soon as the total track length is greater than 25 mm and the momentum of the particle, pz, is less than a value which depends on the charge. The limit is for magnesium $p_{12}=1.2$ GeV/c per nucleon and for iron $p_{26}\simeq 1.5$ GeV/c per nucleon. In an interval 1.2–1.7 GeV/c per nucleon for magnesium and 1.5–2.0 GeV/c per nucleon for iron the rate of change of MTW is too small to be used for identifications. If a particle falling in this interval is identified solely from MTW measurements the apparent charge will be one unit too high. For $p_{12}>1.7$ GeV/c per nucleon and $p_{26}>2.0$ GeV/c per nucleon correct identification is possible from the MTW value only. *Subject Headings:* **1. Primary cosmic rays 2. Heavy nuclei in cosmic radiation 3. Photometry of cosmic rays 4. Chemical composition of cosmic rays.**—*Authors' abstract.* Ⓢ

11.12–234 551.521.64:537.591.2

†McCracken, K. G. (*Physics Dept., Univ. of Tasmania, Hobart, Tasmania*), **Energy dependence of transient changes in the primary cosmic-ray spectrum.** *Physical Review*, N. Y., 17(6):1570–1579, March 15, **1960.** 5 figs., 8 tables, 31 refs., 4 eqs. **DWB**—Quantitative comparisons are made between the cosmic-ray intensity variations observed by a Geiger counter telescope and ionization chamber at a high geomagnetic latitude, high latitude neutron monitors at sea level, and at two different mountain altitudes, Geiger counter telescopes situated 40 meters of water equivalent underground, and a neutron monitor and Geiger counter telescopes at a low geomagnetic latitude. Long-term and short-term variations are considered. As the intensity variations were large, and as the instruments were all of good statistical accuracy, considerable reliance can be placed in the determinations. It is shown that similar comparisons published by other investigators are in agreement with these determinations, provided adequate allowance is made for the altitudes at which the data were obtained. Writing the differential energy spectrum of the primary cosmic radiation as $j(E)$, and measuring E in Bev, the inter-instrument comparisons are used to show that the average spectral changes approximate to the law $\delta j(E)=\text{const}\ (1+E)^{-\beta}j(E)$; where $\beta\approx 0.09$ for short-term variations, and $\beta\approx 1.2$ for long-term variations. It is shown that the amplitude of the long-term variation is markedly dependent upon altitude. Some evidence is presented that there might be a north-south asymmetry in the long-term variation, the amplitude being greater in southerly directions. *Subject Headings:* **1. Cosmic ray spectrum 2. Cosmic ray variations.**—*Author's abstract.* Ⓢ

11.12–235 551.507.362.1:551.508.99:551.521.64

McDiarmid, I. B. and Rose, D. C. (*both, Nat. Res. Council, Ottawa*), **High altitude cosmic ray measurements at Fort Churchill.** *Canadian Journal of Physics*, Ottawa, 38(5):638–641, May **1960.** 2 figs., table, 8 refs. **DWB, DLC**—Measurements with rocket-borne Geiger counters have been carried out at altitudes up to 250 km at Fort Churchill, Manitoba. The total primary cosmic ray intensity at a time near a solar maximum has been determined and compared with other measurements taken at times of high solar activity and also with other Geiger counter measurements obtained near a solar minimum. A low-energy radiation was observed whose intensity increased with altitude up to about 25% of the primary intensity

at 250 km. *Subject Headings:* **1. Rocket-borne instruments 2. Geiger counters 3. Cosmic ray measurement techniques 4. Primary cosmic ray intensities.**—*Authors' abstract.* Ⓢ

11.12–236 537.5 551.521.64

McDonald, F. B. (*N. A. S. A., Goddard Space Flight Center, Wash., D. C.*) and Webber, W. R. (*Imperial College, London*), **Changes in the low-rigidity primary cosmic radiation during the large Forbush decrease of May 12, 1959.** *Journal of Geophysical Research*, Wash., D. C., 65(2):767–770, Feb. **1960.** 2 figs., table, 6 refs. **DLC**—The particular Forbush decrease occurring on May 12, was indistinguishable in its effects on low-rigidity cosmic-ray protons and α particles from the effects of the long-term variation which has been monitored in more than 10 flights with identical detectors at high latitudes. By this the authors do not mean to imply that the two types of changes are caused by the same mechanism, only that the end results appear to be the same in the low-rigidity region. The difference in mechanism may prove to be basically only a difference in scale. *Subject Headings:* **1. Primary cosmic rays 2. Cosmic ray decreases.**—*E.Z.S.* Ⓢ

11.12–237 551.521.64

Marx, George (*Cent. Res. Inst. Physics, Budapest, Hungary*), **Cosmic neutrino radiation.** *Science*, Wash., D. C., 131(3396):299–300, Jan. 29, **1960.** fig., 9 refs., 3 eqs. **DLC**—In order to present a more quantitative picture of the most penetrating radiation of the universe, this paper discusses the experimental technique which makes possible the detection of a reactor anti-neutrino flux of intensity in the energy interval 2 to 6 Mev., using a formula with respect to the fundamental energy-producing process of the sun and the correlation between heavy nuclei and compressed state of matter. More intensive investigation, comparing previous results, has dealt with the energy spectrum of neutrinos emitted in the H-D and C-N type fusion processes with the energy dependence of the cross section for neutrino detection, and the character and intensity of the neutrino radiation, chemical elements, density of neutrons, and thermodynamic equilibrium between neutrinos and atoms. It is concluded that the most difficult problem is that of eliminating the neutrino radiation emitted by the sun and that of the antineutrino flux of terrestrial radioactivity; this background intensity is of a greater order of magnitude than the cosmic flux to be detected. *Subject Heading:* **1. Cosmic ray neutrinos.**—*K.C.* Ⓢ

11.12–238 551.521.64

Maze, R. (*Cosmic Ray Lab. Ecole Norm. Superieure, Paris*) and Zawadzki, A. (*Cosmic Ray Lab., Lodz*), **On an attempt of detection of primary cosmic photons of very high energy.** *Il Nuovo Cimento*, Bologna, Ser. 10, 17(5):625–633, Sept. 1, **1960.** fig., 10 foot refs., 7 eqs. Italian summary p. 633. **DLC**—In relation to the primary proton flux of very high energy ($(10^{15} \div 10^{16})$ eV), the possible photon flux of equal energy created by the p-p collisions of protons with the diffused matter of the Universe, is evaluated taking into account the multiple production of the π°-mesons and their decay. If a trace of very high energy photons exists among the primary flux, two types of EAS must be produced in the air: 1) ordinary EAS; 2) pure photon-electron cascades. Taking advantage of the difference between the number of electrons produced at sea level by a protonic and by a photonic EAS of equal energy (therefore resulting in an amplification factor of the observable effect by at least ten times) it is shown that it is possible to separate these two types by studying the penetrating component with the help of a large detection area and to disclose a real limit rate as small as 10^{-4}. Considering current cosmological estimates, it gives some possibility of observing a significant rate. This method therefore may give new experimental information on the origin of cosmic rays and on individual interaction at very high energy. *Subject Headings:* **1. Cosmic ray photons 2. Cosmic ray origin.**—*Authors' abstract.* Ⓢ

11.12–239 551.521.64

Meyer, Peter (*Enrico Fermi Inst. for Nuclear Studies, Univ. Chicago*), **Intensity variations of primary cosmic-ray components.** *American Geophysical Union*, Transactions, 41(1):81–86, March **1960.** fig., 3 tables. **DWB, DLC**—A paper reporting two series of measurements of

the proton and alpha-particle fluxes of the primary cosmic radiation, made in 1957 and 1958, using balloon-borne scintillation and Cerenkov counters. On one of the flight series, measurements were obtained before, during, and after a large Forbush-type intensity decrease which occurred on Aug. 30, 1957. *Subject Headings:* **1. Cosmic ray variations 2. Primary cosmic ray intensities 3. Cosmic ray decreases.**—*I.S.* Ⓢ

11.12–240 551.521.64

Ney, E. P. (*School of Physics, Univ. of Minnesota*), **Cosmic rays as received at the Earth.** *Astrophysical Journal, Suppl. Ser.*, Chicago, 4(44):371–377, June **1960.** 4 figs., 2 tables. **DLC**—The highest energy cosmic rays give information about their origin and seem to favor extragalactic sources. The relative abundances in cosmic rays reflect not only the sources but, through the lithium, beryllium, and boron, the effect of the interstellar medium through which the cosmic rays must propagate. At the very lowest energies, the intensity and variations in intensity of cosmic rays as received at the Earth show the effect of the Sun and its hydromagnetic beam in modulating and injecting cosmic rays. Tables show the cosmic-ray abundances at the top of the atmosphere. Abundances determined from cosmic-ray ratios are compared with "universal abundances." Figures show graphically: magnetic rigidity versus energy per nucleon for protons, electrons, and heavy nuclei; the energy spectrum of cosmic-ray protons over the entire rigidity range in which fluxes can be measured or inferred (this figure shows results of MIT air-shower experiment); the MIT results on the arrival directions of the highest energy cosmic rays as determined by the directions of the air showers they produced; and fluxes of protons and α-particles as they are observed at the latitude of Minnesota in high-altitude balloon flights. *Subject Heading:* **1. Cosmic radiation.**—*E.Z.S.* Ⓢ

11.12–241 551.521.64

Orsini, C. Q. (*Istituto Fisica Univ., Torino*), **On the relative abundance of carbon, nitrogen and oxygen in the cosmic rays.** *Il Nuovo Cimento*, Bologna, Ser. 10, 16(6):1040–1045, June 16, **1960.** fig., 3 tables, 11 refs. Italian summary p. 1045. **DLC**—Plates (33 G-5 emulsions) were exposed at an atmospheric depth of approximately 6 g/m². Gap length measurements of 220 medium nuclei have these ratios C:N:O::1.5:0.97:1.0. By using different parameters in the diffusion equation we were unable to obtain agreement with the values of SUESS and UREY'S cosmic abundances. The results indicate that the chemical composition of the sources of cosmic rays is different from the mean composition of the universe. *Subject Headings:* **1. Cosmic ray nucleon distribution 2. Chemical composition of cosmic rays.** —*Author's abstract.* Ⓢ

11.12–242 551.510.53:551.521.64

Rymko, N. P.; Tulinov, V. F. and Charakhch'ian, A. N., **Sluchaĭ bol'shogo vozrastaniia intensivnosti kosmicheskogo izlucheniia v stratosfere.** [A case of large increase in the intensity of cosmic radiation in the stratosphere.] *Zhurnal Eksperimental'noĭ i Teoreticheskoĭ Fiziki*, Moscow, 36(6):1687–1689, June **1959.** 2 figs., 2 refs. Russian summary, p. 1687; English summary p. 1689. **DWB.** Transl. into English in corresponding issue of *Soviet Physics JETP*, New York. **DLC**—An increase of the intensity of cosmic radiation was observed in the stratosphere on July 8, 1958 at a latitude of 64°N. At an altitude of 30 km the intensity was more than twice the normal value. On the other hand, at latitudes of 51° and 41° no increase was observed. *Subject Headings:* **1. Cosmic ray intensities 2. Cosmic ray variations at high altitudes 3. Latitude effects on cosmic rays.**—*Authors' abstract.* Ⓢ

11.12–243 551.521.64:537.591.2

van Heerden, I. J. and Judek, B., **The relative abundances of cosmic ray nuclei of charge $Z \geqslant 3$.** *Canadian Journal of Physics*, Ottawa, 38(7):964–967, July **1960.** fig., 3 tables, 10 refs. **DWB, DLC**—A stack of 72 Ilford G5 stripped emulsions, 12 in.×9 in.×600μm, was flown from Brownwood, Texas for 7.5 hours at a ceiling height of 136,000 feet. With the packing material surrounding the stack the total amount of matter above the emulsions was equal to 3.2 g/cm², which is less than in previous investigations. A total of 612 tracks satisfying the selection criteria were found. The number of nuclei in different charge groups and correction to the

top of stack for ascent and descent are tabulated. The value of 0.20 ± 0.02 for the relative abundance of light nuclei is in experimental agreement with some works' results. The absolute fluxes are considerably lower than those obtained by previous observers. This may be attributed to a period of low cosmic ray intensity. *Subject Headings:* **1. Cosmic ray nucleons 2. Cosmic ray spectrum.**—*E.Z.S.* Ⓢ

11.12–244 551.521.64

Waddington, C. J. (*H.H. Wills Physical Lab., Univ. of Bristol*), **Relative abundances of the heavy nuclei in the primary cosmic radiation.** *Philosophical Magazine*, London, 5(52):311–324, April **1960.** 2 figs., 3 tables, 19 refs., eq. **DWB, DLC**—In an attempt to resolve the current controversy about the relative abundances of the heavy, $Z \geqslant 6$, nuclei in the primary cosmic radiation, the magnitude of the corrections introduced by the overlying atmosphere has been redetermined. For this reason it has been necessary to use nuclear emulsions to determine the fragmentation parameters of nuclei having $20 \leqslant Z \leqslant 28$. The results of this work show that the relative abundances calculated previously by considering the diffusion of nuclei through the atmosphere were not seriously in error, and that outside the atmosphere the ratio of H, $Z \geqslant 10$, to M, $6 \leqslant Z \leqslant 9$, nuclei is 0.38 ± 0.04. The significance of this result is considered briefly. *Subject Headings:* **1. Cosmic ray nucleon distribution 2. Primary cosmic ray intensities.**—*Author's abstract.* Ⓢ

G. Solar Component

See also: **Solar radio bursts and low-energy cosmic rays** (Thompson, Maxewell), 11.12-60 **Van Allen radition of solar origin** (Kellog), 11.12-279.

11.12–245' 551.521.64:523.75

Charakhch'ian, A. N.; Tulinov, V. F. and Charakhch'ian, T. N., **Kosmicheskie luchi ot Solntsa.** [Cosmic rays from the sun.] *Zhurnal Eksperimental'noĭ i Teoreticheskoĭ Fiziki*, Moscow, 39(2):249–256, Aug. **1960.** 6 figs., 5 refs. Russian summary p. 249; English summary p. 256. **DWB.** Transl. into English in corresponding issue of *Soviet Physics JETP*, New York.—A number of cosmic ray flares have been observed in the stratosphere at a geomagnetic latitude of 64°. The flares are due to 100–200 MeV protons. These intensity bursts were preceded by solar chromosphere flares which are the source of the protons of the indicated energies. It is suggested that these protons are carried by solar corpuscular beams with magnetic fields frozen inside them. *Subject Headings:* **1. Cosmic ray origin 2. Chromospheric flares 3. Corpuscular emissions from sun 4. Solar cosmic ray propagation models 5. Solar flare effects on cosmic rays.**—*Authors' abstract.* Ⓢ

11.12–246 551.521.64

Danielson, Robert E. (*Princeton Univ. Obs.*), **An attempt to detect energetic gamma radiation from the sun.** *Journal of Geophysical Research*, Wash., D. C., 65(7):2055–2059, July **1960.** 4 figs., 3 refs. **DLC**—A γ-ray telescope was constructed to detect solar γ rays with energies greater than about 200 Mev. This telescope was manually operated during a Stratolab flight for about 40 min. An upper limit to the flux of γ radiation from the sun during this time was found to be 0.008 photon/cm² sec. This is roughly 1% of the cosmic-ray flux. *Subject Headings:* **1. Cosmic ray instruments 2. Cosmic ray balloon research 3. Solar gamma rays.**—*Author's abstract.* Ⓢ

11.12–247 523.164.32 551.507.321:551.521.64

Freier, P. S.; Ney, E. P. and Winckler, J. R. (*all, School of Physics, Univ. of Minnesota,*) **Balloon observation of solar cosmic rays on March 26, 1958.** *Journal of Geophysical Research*, Wash., D. C., 64(6):685–688, June **1959.** 2 figs., 4 refs. **DWB, DLC**—Solar and terrestrial phenomena, climaxed in low-energy cosmic rays, arriving at the earth, are described. A solar flare of importance 3+, and duration of 248 minutes, began at 9050 UT on March 23. It produced a Type IV radio noise storm on the Sun with radio emission at all frequencies from 169 to 9400 mc., and a short-wave fade out of importance 3 on the Earth. The solar cloud arrived at the Earth on March 25 at 1540 UT as a sudden magnetic storm, followed by a

ecrease of sea level cosmic rays between March 25 and 26. A neutron intensity decrease rom March 25 to early April at Deep River, Canada with absorption of cosmic noise at Ft. Yukon, Alaska is plotted on Fig. 1. This absorption was caused supposedly by the arrival of harged particles at the earth, increasing the ionization of the D layer of the ionosphere. Balloon flights (equipment described) took place on March 21, 26, and April 8. Fig. 2 illustrates the average flux of protons, and alpha particles as well as the total particle count rate, nd main ionization. The presence of low-rigidity particles is explained by distortion of the Störmer cut-offs by the solar beams. The delayed arrival of cosmic rays is interpreted either by continuous acceleration and injection of cosmic rays at the Sun or by storage of particles ccelerated during the solar flare or by release of trapped particles in the Van Allen belt. Presumably the particles observed March 26 were accelerated in the flare of March 23, stored n the solar corona and propagated to the earth in the magnetic channel also arising from the March 23 flare. *Subject Headings:* **1. Solar flare effects on cosmic rays 2. Cosmic ray balloon esearch 4. Solar cosmic ray propagation models.**—*O.T.* Ⓢ

11.12–248 523.75:551.521.64

Freier, P. S.; Ney, E. P. and Winckler, J. R. (*all, School of Physics, Univ. Minnesota*), **Observation of solar cosmic rays.** *American Geophysical Union, Transactions*, 40(3):269–273, Sept. 1959. 2 figs. **DWB.** Also in *International Space Science Symposium, Nice, Jan. 1960, Space Research: Proceedings of the First Symposium.* Pub. **1960.** p. 897–909. 4 figs., table, 13 refs. Russian summary p. 897–898. **DWB** (523.1 161sp)—Solar and terrestrial phenomena occurred late in March 1958, culminating in the arrival at the earth of low-energy cosmic rays. These events probably resulted from a solar flare of importance 3+. Significant features are: the presence of particles with rigidities lower than the normal cut-off rigidity for the geomagnetic latitude of Minneapolis and the delayed arrival of cosmic rays following the solar flare of March 23. The presence of low-rigidity particles indicates distortion of the Störmer cut-offs by the solar beam ejected by the flare. The late arrival of cosmic rays indicates storage in the solar corona of particles accelerated during the solar flare. The particles may have arrived at the earth after being diffused into the magnetic channel associated with the solar beam. *Subject Headings:* **1. Solar flare effects on cosmic rays 2. Solar cosmic ray propagation models.**—*E.Z.S.* Ⓢ

11.12–249 551.521.64:523.74

Fukushima, Shin (*Inst. Phys. Chem. Res.*) and Kitamura, Taiichi (*Inst. Geophys. Kyoto Univ.*), **Report on results of cosmic-ray observations on m/s "Soya" during the period from November, 1958 to April 1959.** *Antarctic Record*, Tokyo, No. 10:9–18, March **1960.** 6 figs., 2 tables, 3 refs. In Japanese; English summary p. 9–10. **DWB**—The routine observations of cosmic-ray nucleonic component carried out on board the "Soya" are reported, graphically represented, and their results are compared with the results of the first expedition (1956–57) in order to make clear the dependence of cosmic-ray latitude effect upon the change of solar activity. After showing the solar activity during the periods of two surveys, several properties of cosmic-ray rigidity spectrum, cosmic-ray equator and latitude lines are compared for the two surveys. Based on this study, it is concluded that the secular variation of cosmic rays does not immediately follow that of solar activity, but after some time. *Subject Headings:* **1. Cosmic ray nucleons 2. Solar effects on cosmic rays 3. Secular solar activity variations 4. Cosmic ray variations.**—*I.S.* Ⓢ

11.12–250 551.521.64:523.75

Ghielmetti, H.; Anderson, J. C.; Cardoso, J. M. et al. (*all, Comm. Nac. Atomic Energy, Buenos Aires*), **Solar flare effects on cosmic ray intensity.** *Il Nuovo Cimento*, Bologna, Ser. 10, 15(1):87–98, Jan. 1, **1960.** 8 figs., table, 16 foot refs. Italian summary p. 98. **DLC**—In order to look for small cosmic ray increases associated with the development of solar flares, data from two neutron monitors located in the Southern Hemisphere were analyzed. Solar flares of magnitude 2 or greater were selected, and the analysis was carried out for the detectors being located within the morning impact zones. The behavior of nucleonic intensity, corrected for superposed daily variation, did not show any significative increase over the "zero hour."

This result contrasts with that of FIROR, but agrees with the more recent paper by TOWLE and LOCKWOOD. However, in the present work and for one station, there appears a significant peak if another type of correction is applied. Furthermore, another significant increase arises several hours after the onset of solar flares, closely peaked around the time of maximum in the mean daily variation. Data examined were extracted from records of the University of Tasmania at Mount Wellington (Hobart, Tasmania) and Mawson (Antarctica). The period investigated is July 1957 to August 1958. *Subject Headings:* **1. Solar flare effects on cosmic rays 2. Cosmic ray intensities 3. Hobart, Tasmania 4. Mawson, Antarctica. I. Manzano, J. R. II. Roederer, J. G. III. Santochi, O. R.**—*Authors' abstract.* Ⓢ

11.12–251 551.521.64:523.036.515

Newkirk, G. A.; Warwick, J. W. and Zirin, H. (*all, Univ. Colorado*), **Backscatter of cosmic rays by the sun's H II sphere.** *Journal of Geophysical Research*, Wash., D. C., 65(8):2540–2542, Aug. **1960.** table, 13 refs., 5 eqs. **DLC**—The field-free cavity model suggested by MEYER, PARKER, and SIMPSON 1956 can be deduced by consideration of the sun's H II sphere. The model of a field-free hollow around the sun can be explained either by the dynamic pressure of the solar wind or by the static pressure of the hot interplanetary gas. The existence of high temperatures in the interplanetary medium must follow from the ionization of hydrogen by Lyman continuum and He II ultraviolet radiation. *Subject Headings:* **1. Cosmic ray backscatter 2. Sun's H II sphere.**—*E.Z.S.* Ⓢ

11.12–252 551.521.64:523.75

Palmeira, R. A. R. and McCracken, K. G. (*both, Physics Dept. & Lab. for Nuclear Science, Mass. Inst. of Technology, Cambridge, Mass.*), **Observation of a short-lived cosmic-ray solar flare increase with a high-counting-rate meson detector.** *Physical Review Letters*, N. Y., 5(1):15–16, July **1, 1960.** fig., 2 refs. **DLC**—A very abrupt and short-lived cosmic-ray increase was observed at M. I. T. on May 4, 1960. According to a preliminary report issued at Boulder, Colorado, a flare of importance 2 was observed at 10:20 U.T. in an active region on the western solar limb. We conclude that the cosmic radiation was generated in this flare. The most outstanding feature of the cosmic ray effect is the very short time scale of this event. The 30-second meson data observed at M. I. T. subsequent to the production of cosmic rays by the Sun on May 4, 1960 is displayed. *Subject Headings:* **1. Cosmic ray intensities 2. Solar flare effects on cosmic rays.**—*E.Z.S.* Ⓢ

11.12–253 551.507.321/362:551.521.64:550.385.4

Rothwell, Pamela (*State Univ. of Iowa*), **Magnetic cutoff rigidities of charged particles in the earth's field at times of magnetic storms.** *Journal of Geophysical Research*, Wash., D. C., 64(11):2026–2028, Nov. **1959.** table, 6 refs., 9 eqs. **DLC**—The evaluation of recent observations obtained from balloons and satellites, indicates that the low energy solar cosmic rays that quite frequently bombard the upper atmosphere at high latitudes for several days after a large solar flare can arrive at a given location with energies below the usual magnetic cutoff energy after the onset of the magnetic storm associated with the flare. *Subject Headings:* **1. Solar flare effects on cosmic rays 2. Magnetic effects on cosmic rays 3. Cosmic ray balloon research 4. Satellite cosmic ray data.**—*E.K.* Ⓢ

11.12–254 551.521.64:523.75

Towle, L. C. and Lockwood, J. A. (*both, N. Hampshire Univ., Durham*), **Cosmic-ray increases associated with solar flares.** *Physical Review*, N. Y., 113(2):641–647, Jan. 15, **1959.** 6 figs., 4 tables, 26 refs. **DWB**—Data from a standard IGY neutron monitor located on Mt. Washington, N. H., have been examined for possible increases associated with solar flares. The 0400 and 0900 impact zones have been located for both the standard centered dipole and the westward rotated centered dipole approximations. No increases $\geq 0.25\%$ have been found for the years 1956 and 1957. An additional maximum in the mean daily cycle at the time of impact zone passage has not been observed during this period. Possible explanations for this result are presented. *Subject Headings:* **1. Solar flare effects on cosmic rays 2. Cosmic ray intensities.**—*Authors' abstract.* Ⓢ

H. Showers

11.12–255 551.521.64

Andronikashvili, E. L. and Roĭnishvili, N. N., **O poperechnoĭ sostavliaiushcheĭ impuls'sa strannykh chastits, generirovannykh v pronikaiushchikh livniakh kosmicheskogo izlucheniia.** [Transverse momentum component of strange particles produced in penetrating cosmic ray showers.] *Zhurnal Eksperimental'noĭ i Teoreticheskoĭ Fiziki*, Moscow, 39(2):267–270, Aug. **1960.** 4 figs., 7 refs. Russian summary p. 267; English summary p. 270. **DWB.** Transl. into English in corresponding issue of *Soviet Physics JETP*, New York. **DLC**—Results of measurement of the transverse momenta of strange particles produced by cosmic radiation are presented. It is shown that the mean value of the transverse momentum of heavy unstable particles is (0.52 ± 0.06) BeV/c. Within the limits of the experimental errors it is independent of the type of strange particle and energy of the primary particle in the interval $(1\div10):10^{10}$eV. *Subject Headings:* **1. Cosmic ray showers 2. Cosmic ray particles 3. Penetrating shower secondaries.**—*Authors' abstract.* Ⓢ

11.12–256 551.521.64:535.242

Bartke, J.; Ciok, P.; Gierula, J. et al. (*all, Inst. Nuclear Res. Kraków and Warsaw*), **The angular distribution of secondary particles in high energy nuclear collisions with heavy nuclei of photographic emulsion.** *Il Nuovo Cimento*, Bologna, Ser. 10, 15(1):18–24, Jan. 1, **1960.** 4 figs., table, 6 foot refs., eq. Italian summary p. 24. **DLC**—61 jets produced by singly charged and neutral particles of cosmic radiation in photographic emulsion in collisions with heavy nuclei ($N_h>8$) have been investigated. Primary energies and anisotropy parameters for angular distributions of secondary particles have been calculated. The results were compared with those obtained formerly for events with small evaporation ($N_h\leqslant5$). It might be stated that the energy dependence of the anisotropy for both samples of jets is quite similar. The mean anisotropy is however smaller than that predicted by hydrodynamical theories. It was stated that in the same energy interval the anisotropy for particular events differ very much and that the main contribution to high anisotropy is given by the case in which the angular distribution $dN/d(\log tg\theta)$ is not a normal one, but shows two separated maxima. The results were discussed from the point of view of the two-center model. *Subject Heading:* **1. Photometry of cosmic rays. I. Hołyński, R. II. Mięsowicz, M. III. Saniewska, T.**—*Authors' abstract.* Ⓢ

11.12–257 523.165

Camerini, U.; Fry, W. F.; Groves, T. and Huzita, H. (*all, Univ. Wisconsin, Madison*), **A fast hyperfragment produced by a heavy primary cosmic ray.** *Il Nuovo Cimento*, Bologna, Ser. 10, 15(3):498–499, Feb. 1, **1960.** table. **DLC**—A brief note describing an event which is interpreted as a decay in flight of a $^4H_\Lambda$. The primary star was produced by a heavy primary, probably carbon. The track of the hyperfragment is nearly black and after 2.2 mm. there is a change in direction of 63° and a reduction in ionization to that of a proton of 115 MeV. The angle between the directions of the heavy primary and the hyperfragment is 30°. The multiple scattering and gap measurements along the connecting track indicate a mass equal to $3600\pm1200/500$ MeV. This together with the marked decrease in ionization at the decay point, identify the connecting particle as a $^4H_\Lambda$. The characteristics of the hyperfragment are summarized. *Subject Headings:* **1. Cosmic ray properties 2. Cosmic ray primary particles 3. Cosmic ray hyperfragments.**—*E.S.* Ⓢ

11.12–258 551.521.64:551.508.91

Gémesy, T.; Sandor, T. and Somogyi, A. (*all, Hungarian Acad. Sci., Budapest*), **Cloud chamber study of extensive air showers.** *Il Nuovo Cimento*, Bologna, Ser. 10, 16(3):412–415, May 1, **1960.** 3 figs., table, 3 foot refs. Italian summary p. 415. **DLC**—Measurements were carried out by means of a multiplate cloud chamber controlled by an extensive air shower arrangement in order to check the authors' earlier results concerning the transition effect of the extensive air showers as well as to determine a more precise value of the photon/electron ratio. *Subject Headings:* **1. Cosmic ray showers 2. Cloud chamber studies.**—*Authors' abstract.* Ⓢ

11.12–259 551.521.64:551.594.12

Goldberg, A. (*Inst. of Theoretical Physics, Dept. of Physics, Stanford Univ., Calif.*), **Flux at sea level of heavy charged particles pair-produced in cosmic ray showers.** *Physical Review*, N. Y., 117(4):1128–1129, Feb. 15, 1960. 13 foot-refs., eqs. **DWB**—The flux at sea level of charged particles with mass 300–600 electron masses is calculated assuming the particles to be pair-produced by cosmic ray photons. The cross section for pair production, including the effects of nuclear size, is folded into the distribution of photons predicted by shower theory. Absorption of the produced particles is also considered approximately. The results are well below the experimental upper limit set up by KEUFFEL and co-workers. *Subject Headings:* **1. Cosmic ray particles at sea level 2. Cosmic ray showers.**—*Author's abstract.* Ⓢ

11.12–260 551.521.64:551.508.91

Higashi, S.; Mitani, S.; Oshio, T. et al. (*all, Osaka Univ.*), **Cloud chamber study of penetrating showers underground.** *Il Nuovo Cimento*, Bologna, Ser. 10, 13(2):265–283, July 16, 1959. 8 figs., 7 tables, 29 foot refs., eqs. Italian summary p. 282–283. **DLC**—A multiplate cloud chamber containing fifteen lead plates 1 cm thick was used to observe penetrating showers underground. Fifteen and twenty-three penetrating showers, having four secondary shower particles on the average, have been obtained during 667.9 h and 3 603.1 h at 50 m w. e. and 250 m w. e., respectively. Special attention was paid to distinguish penetrating showers produced by μ-mesons from those by the nucleonic component, the chamber of large width (100 cm) having been set as close to the upper wall in the tunnel as possible. Almost all of the observed showers produced by isolated incident particles are considered as probably produced by μ-mesons (named P-showers phenomenologically), and those by one of two or more incident particles as due to the nucleonic component (named S-showers), since the m.f.p. of the nucleonic component for nuclear interaction is about 10^{-4} times shorter than that of μ-mesons. After correcting for the triggering efficiency of the apparatus, the ratios of frequencies of S-showers to that of P-showers have turned out to be 1.1 ± 0.3 and 0.92 ± 0.23 at both depths, which means that a half of the high energy nuclear interactions underground is produced by the nucleonic component. The depth dependence of frequencies of P-showers is compared with the prediction by WEIZSÄCKER and WILLIAMS's treatment of μ-meson interactions. In addition, it has remarkably been observed that P-showers have a characteristic different from that of S-showers, i.e., the average number of heavily ionizing secondaries of P-showers is 0.3 per shower, while the value of S-showers is 2.8 per shower. *Subject Headings:* **1. Cosmic ray ground penetration 2. Cloud chamber studies 3. Penetrating showers. I. Shibata, H. II. Watanabe, K. III. Watase, Y.**—*Authors' abstract.* Ⓢ

11.12–261 551.521.64

Narayan, D. S. and Yodh, G. B. (*both, Tata Inst. Fund. Research, Bombay*), **On the $\mathfrak{N}$-component in extensive air showers.** *Il Nuovo Cimento*, Bologna, Ser. 10, 16(6):1020–1039, June 16, 1960. 5 figs., 11 foot refs., 34 eqs. Italian summary p. 1039. **DLC**—According to NIKOLSKIĬ et al. (1957), the number of nuclear-active ($\mathfrak{N}$) particles in air showers increases fairly slowly, as $E^{2.2}$, for showers ranging in energy from 10^{13} eV to 10^{15} eV. At energies $>10^{15}$ eV the increase is more rapid and is αE. This variation in the $\mathfrak{N}$-component with the size of the shower and certain other observed features of air showers have been interpreted previously as an indication of a change in the nature of nuclear interactions at very high energies or as an indication of specific details in the nature and composition of the primary cosmic radiation, such as the existence of a cut-off in the magnetic rigidity of the particles and the predominance of heavy primaries at very high energies. In this paper an attempt is made to explain the above observed features in terms of certain characteristics of nucleon-nucleus (n-$\mathfrak{N}$) pion-nucleus (π-$\mathfrak{N}$) collisions; the term "nucleus" here refers to an "air nucleus." The main aspect of the (NIKOLSKIĬ) curve, for the abundance of $\mathfrak{N}$-particles vs. shower energy, considered here, is not the rapid increase of the $\mathfrak{N}$-component in showers of energy $>10^{15}$ eV, nor the existence of a change in the abundance of $\mathfrak{N}$-particles in going from small showers to big showers, but rather the fairly slow increase in the number of $\mathfrak{N}$-particles in showers of energy $(10^{13} \div 10^{15})$ eV. This slow increase, which is contrary to general experience in cascade calculations, puts stringent limitations on the choice of parameters that characterize n-$\mathfrak{N}$ and π-$\mathfrak{N}$ collisions. It is shown that n-$\mathfrak{N}$ and π-$\mathfrak{N}$ collisions are largely elastic and that

the number of secondary nucleons produced in such collisions is quite small (of the order of one or two); further, in a π-$\mathfrak{N}$ collision, the energy going into the nucleon component is a very small fraction of the energy of the incident pion. These features also result in a rapid increase in the $\mathfrak{N}$-component of big showers; this arises as a result of the complicated role played by charged pions owing to their finite life time. In small showers the charged pions have only small energies and hence they mostly decay and do not contribute appreciably to the $\mathfrak{N}$-component. In big showers, however, the pions have sufficiently high energy to make nuclear interactions before decaying and owing to the large multiplicity of pions produced in n-$\mathfrak{N}$ and π-$\mathfrak{N}$ collisions, there is a rapid increase in the number of $\mathfrak{N}$-particles with increasing energy of the shower. Some experiments are suggested to distinguish between the various possible explanations. *Subject Headings:* **1. Cosmic ray showers 2. Cascade theory 3. Nucleonic components of cosmic rays.**—*Authors' abstract.* Ⓢ

11.12–262 551.521.64:551.594.12

Ozaki, Seinosuke (*Lab. of Nuclear Studies, Cornell Univ., Ithaca, N. Y.*), **Latitude effect on extensive air showers of cosmic rays.** *Physical Review*, N. Y., 117(4):1125–1127, Feb. 15, **1960.** 2 figs., 8 foot-refs., eqs. **DWB**—The variation of air shower counting rate with latitude has been measured between 7° and 50°N at sea level. The observed showers have 10^6 charged particles on the average. Within the statistical accuracy, a few percent, no latitude effect on the intensity has been obtained. *Subject Headings:* **1. Cosmic ray showers 2. Latitude effects on cosmic rays.**—*Author's abstract.* Ⓢ

11.12–263 551.521.64:537.591.2

Pernegr, J.; Šimák, V. and Votruba, M. (*all, Inst. Physics Czech. Acad. Sc., Prague*), **On the momentum spectrum of particles in cosmic ray jets.** *Il Nuovo Cimento*, Bologna, Ser. 10, 17(2):129–133, July 16, **1960.** 4 figs., 11 refs., 3 eqs. Italian summary p. 133. **DLC**—It is shown that the form of momentum spectrum of jet particles is essentially dependent on the degree of anisotropy of the angular distribution, and that e.g. the form dp/p^2 corresponds to a definite "medium" anisotropy. Integral spectra of directly measured values of p indicate a systematic decrease of transversal momenta in the vicinity of the axis and of the $\pi/2$-plane in C.M. system. *Subject Headings:* **1. Cosmic ray showers 2. Cosmic ray spectrum.**—*Authors' abstract.* Ⓢ

11.12–264 551.521.64:539.18

Yekutieli, G. (*Weizmann Inst. Scien. Rehovoth*), **On the radiation of mesons with a constant transverse momentum P_T in cosmic ray jets.** *Il Nuovo Cimento, Bologna*, Ser. 10, 13(2):446–447, July 16, **1959.** 3 foot refs., eq. **DLC**—The resemblance of production of mesons with a constant transverse momentum in high energy nuclear interactions to the Čerenkov radiation is analyzed. The model applied predicts the independence of primary energy at very high energy meson multiplicity and its slow increase with nucleus size. *Subject Headings:* **1. Cosmic ray showers 2. Meson production.**—*O.T.* Ⓢ

I. Isotope Production

See also: **Cosmic-ray-produced rare gases in meteorites** (Signer, Nier), 11.12–148; **Cosmic-ray exposure ages of meteorites** (Whipple, Fireman), 11.12–149.

11.12–265 551.521.64:551.324.24:550.9(98/99)

Lal, Devendra; Goldberg, Edward D. and Koide, Minoru, **Cosmic-ray-produced silicon-32 in nature.** *Science*, Wash., D. C., 131(3397):332–337, Feb. 5, **1960.** 3 figs., table, 19 refs., 9 eqs. Also same title in *Physical Review Letters*, N. Y., 3(8):380, Oct. **1959.** ref. **DLC**—Describes the effects produced by interaction of cosmic rays on nuclear species. This article concerns Si32, one of the nuclear isotopes. The production rate of Si32 can be calculated from the available cosmic ray data in different parts of the atmosphere. Si32 is one of the main rock forming elements and is involved in biological and inorganic reactions. It can be used in studying problems on characteristics of water masses, change in cosmic ray intensity in last few thousand years and ages of polar ice caps. *Subject Headings:* **1. Cosmic ray data 2. Silicon^{32} 3. Cosmic ray radio-isotopes.**—*A.H.K.* Ⓢ

11.12–266 551.521.64:546.02:539.16:551.509.318

Peters, B. (*Tata Inst. of Fundamental Res., Bombay, India*), **On the use of cosmic ray produced isotopes for studying large scale circulations in the atmosphere.** *Advances in Geophysics*, N. Y., Vol. 6, pub. **1959.** p. 289–296. 4 figs., 10 refs. **DWB, DLC**—The use of radioactive isotopes produced by cosmic rays for tracing the motion of air masses is examined. These isotopes, whose manner of production and production rate within the atmosphere are summarized are beryllium, phosphorus and sulfur. The characteristics of air masses as regards the concentration of their isotopes are discussed. The cleaning of an air mass will occur after decay and production of isotope P^{32} have reached equilibrium, but before the concentration of the much longer-lived isotope S^{35} has reached the saturation point. Air concentrates in the troposphere is on the average cleaned out effectively by wet precipitation about once every 30 or 40 days. If an air mass descends from the stratosphere it has presumably been irradiated for a long period without cleansing and all isotope concentrations will have reached their saturation value. Stratospheric air is therefore recognized by its much larger rates of long-lived to short-lived isotopes; it also has a much larger absolute concentration of isotopes because of the high production rate in the stratosphere. *Subject Headings:* **1. Cosmic ray radio-isotopes 2. Air mass identification.**—*I.L.D.* Ⓢ

3. VAN ALLEN RADIATION BELTS

See also: **The IGY** (Brunt), 11.12–192; **IGY cosmic ray program** (Haymes), 11.12–197; **Energetic particle fluxes** (Gold), 11.12–230; **Argus experiment** (AGU Transactions), 11.12–314; **Pioneer's radiation-detection instrument** (Josias), 11.12–521; **Radiation measurements to 658, 300 km** (Van Allen, Frank), 11.12 -522; **Second IGY space probe** (AGU Transactions), 11.12–523; **Observations of electrons artificially injected into geomagnetic field** (Van Allen et al.), 11.12–579; **Observation of corpuscular radiation** (IGY Satellite Report), 11.12–580; **Penetration of charged particles into ionosphere** (Pletnev), 11.12–581.

11.12–267 551.521.64:537.591.2

Alfvén, Hannes (*Royal Inst. Tech., Stockholm, Sweden*), **Momentum spectrum of the Van Allen radiation.** *Physical Review Letters*, N. Y., 3(10):459–460, Nov. 15, **1959.** fig., 2 refs., eq. **DLC**—A note examining whether the Van Allen radiation can be explained by the same mechanism, "magnetic pumping," which is responsible for the acceleration of cosmic radiation. The spectrum of the Van Allen radiation is plotted as a function of the momentum. The graphical representation obtained shows agreement with cosmic ray spectrum. *Subject Headings:* **1. Van Allen belts 2. Cosmic ray spectrum.**—*I.S.* Ⓢ

11.12–268 551.507.362.2:551.521.64:550.385.46

Arnoldy, R. L.; Hoffman, R. A. and Winckler, J. R. (*all, Univ. Minnesota*), **Observations of the Van Allen radiation regions during August and September 1959, Pt. 1.** *Journal of Geophysical Research*, Wash., D. C., 65(5):1361–1376, May **1960.** 15 figs., 4 tables, 11 refs., 4 eqs. **DLC, DWB.** Also as **Observations of Van Allen radiation regions during geomagnetic storms.** *International Geophysical Year*, 1957/1958. *IGY World Data Center A (for) Rockets and Satellites, IGY Satellite Report*, No. 11:89–104, June **1960.** 15 figs., 7 refs., 4 eqs. **DWB** (629.1388 I612sa). Also as: **Measurements of the Van Allen radiation belts during geomagnetic storms.** (In: International Space Science Symposium, Nice, Jan. 1960, **Space Research: proceedings of the First Symposium.** Pub. **1960.** p. 877–896. 15 figs., 2 tables, 7 refs., 4 eqs. Russian summary p. 877.) **DWB** (523.1 161sp)—Discussion by A. J. Dessler, *Journal of Geophysical Research*, 65(10):3487–3490, Oct. **1960.** fig., 10 refs. **DLC, DWB**—An integrating ionization chamber and a single Geiger counter were flown on United States satellite Explorer VI to an elliptical orbit extending to 48,000 km. In addition to the Van Allen inner zone and the great outer zone, a stable and distinct intermediate zone was detected throughout August and September 1959. The outer-zone intensity showed a large decrease following the sudden commencement of a geomagnetic storm. Later in the storm the outer zone increased to much in excess of its prestorm level. During stable periods the outer zone was fairly constant and less intense than it had been observed to be with Pioneer III or Pioneer IV or the first

Soviet cosmic rocket. Cosmic-ray background counting rates were reached on most passes in Aug. and Sept. near apogee of the satellite. The radiation 'dumped' from the outer zone during the geomagnetic storm fits very well with the intensity and latitude distribution required to account for balloon observations of auroral X rays made during the IGY period. This paper is based on preliminary analysis of Explorer VI data. *Subject Headings:* **1. U. S. Satellite 1959 Delta (Explorer VI) 2. Van Allen belts 3. Satellite radiation measurements 4. Geomagnetic storm effects. I. Dessler, A. J.**—*Author's abstract.* Ⓢ

11.12–269 551.507.362.2:551.521.64

Chudakov, A. E. and Gorchakov, E. V., **Zemnoe korpuskuliarnoe izluchenie.** [Terrestrial corpuscular radiation.] *Priroda*, Moscow, No. 8:86–89, Aug. **1959.** 3 figs. **DLC**—One of the most interesting and unexpected results of the launching of Earth satellites and cosmic rockets was the discovery of two zones of terrestrial corpuscular radiation located at a distance of thousands and tens of thousands of kilometers from the earth's surface. These zones differ not only by their spatial location but also by the composition of their particles. The author assumes that the external and the internal zones differ also by their origin; the internal zone originated as a result of the neutron mechanism of injection, while the external zone originated due to the intrusion of flows of particles emitted by the sun into the magnetic field of the earth. *Subject Headings:* **1. Satellite radiation measurements 2. Van Allen belts 3. Corpuscular radiation.**—*A.M.P.* Ⓢ

11.12–270 551.521.64

Dessler, A. J. and Vestine, E. H., **Maximum total energy of the Van Allen radiation belt.** *Journal of Geophysical Research*, Wash., D. C., 65(3):1069–1071, March **1960.** 6 refs., 3 eqs. **DLC**—The results of the spherical harmonic analysis of the geomagnetic field place an upper limit on the energy that can be stored in the Van Allen radiation belt. Conservative figures indicate a maximum energy in trapped radiation of 6×10^{15} joules. *Subject Heading:* **1. Van Allen belts.**—*E.Z.S.* Ⓢ

11.12–271 551.507.362.2:551.521.64

Dessler, A. J. (*Lockheed Aircraft Corp., Missiles & Space Div., Palo Alto, Calif.*) and Karplus, Robert (*Dept. of Physics, Univ. of Calif., Berkeley, Calif.*), **Some properties of the Van Allen radiation.** *Physical Review Letters*, N. Y., 4(6):271–274, March 15, **1960.** 2 figs., 20 refs. **DLC**—Results of the observations of the outer zone of the Van Allen radiation belt made with the Explorer IV and Explorer VI satellite systems are inconsistent with the solar injection hypothesis. The electrons released in the decay of cosmic-ray neutron albedo may represent a satisfactory source for the outer zone. An illustrative sketch of particle flux vs. radial distance in the equatorial plan is shown. Correlations with the Capetown anomaly are illustrated in a sketch. Though the entire Van Allen radiation belt is due to neutron decay: the decay of fast neutrons produces the proton belt while the electron belt is attributed to the large number of slow neutrons which decay relatively near the earth. *Subject Heading:* **1. Van Allen belts.**—*E.Z.S.* Ⓢ

11.12–272 551.521.64:550.385

Dyce, R. B. (*Stanford Res. Inst. Menlo Park, Calif.*) and Nakada, M. P. (*Lawrence Radiation Lab., Livermore, Calif.*), **On the possibility of detecting synchrotron radiation from electrons in the Van Allen belts.** *Journal of Geophysical Research*, Wash., D. C., 64(9):1163–1168, Sept. **1959.** 3 figs., table, 12 refs., 7 eqs. **DLC**—It is known that a moving charged particle can be trapped in the Earth's magnetic field indefinitely. Indeed, high-speed charged particles, presumably electrons, have recently been observed in nature by United States satellites and lunar probes. These electrons are relativistic and should emit radiofrequency wide-band noise similar to that observed in synchrotrons even as high as optical frequencies. Most of this energy is unable to reach the Earth's surface because of reflection from the intervening ionosphere. A small fraction of this energy, however, exists at VHF capable of passing down through the ionosphere. It would be desirable to conduct an experimental search for this radiation in order to learn more about the electron energies that exist and to allow ob-

servation of the Van Allen belt as a function of time. *Subject Headings:* **1. Van Allen belts 2. Cosmic ray electrons.**—*Authors' abstract.* Ⓢ

11.12–273 551.521.64:551.507.362.2

Fan, C. Y.; Meyer, P. and Simpson, J. A. (*all, Univ. of Chicago*), **Trapped and cosmic radiation measurements from Explorer VI.** *International Geophysical Year*, 1957/1958. *IGY World Data Center A [for] Rockets and Satellites, IGY Satellite Report*, No. 11:115–125, June **1960.** 11 figs., 8 refs. **DWB** (629.1388 I612sa). Also issued in: International Space Science Symposium, Nice, Jan. 1960, **Space Research: proceedings of the First Symposium.** Pub. **1960.** p. 951–966. **DWB** (523.1 I61sp) –This paper is a preliminary report on three problems, the structure of the Van Allen radiation regions and changes of structure with time; the detection of solar flare high energy particles; the electromagnetic phenomenon of solar origin which leads to modulation of cosmic ray intensity. Instrumentation is explained, and a diagram shows the High Energy Charged particle instrumentations for Explorer VI satellite Aug. 7, 1959. Typical Explorer VI orbits are plotted on a geomagnetic meridian plane. Structure and solar induced changes in the trapped radiation region are discussed. High energy solar flare protons (Sept. 3, 1959) were measured. Good discussion on lower limit on the scale size for the modulation mechanism of galactic cosmic rays. Cosmic radiation intensity for Aug. 8–25, 1959 measured beyond 37,000 km range from the earth is shown graphically. *Subject Headings:* **1. Satellite cosmic ray measurements 2. U. S. Satellite 1959 Delta (Explorer VI) 3. Satellite radiation measurements 4. Van Allen belts 5. Primary cosmic rays.**—*E.Z.S.* Ⓢ

11.12–274 551.521.64:551.507.362.2

Gall, R. and Lifshitz, J. (*both, Inst. Nac. Investg. Científica, México*), **Temporary capture of cosmic ray particles and their contribution to the high intensity belts.** *Il Nuovo Cimento*, Bologna, Ser. 10, 15(2):233–245, Jan. 16, **1960.** 8 figs., 21 foot refs., 5 eqs. Italian summary p. 245. **DLC**—The theory of the temporary permanence of charged particles in the vicinity of unstable principal periodic orbits in the earth's magnetic field is discussed in relation to the high intensity belts surrounding the earth. The intervals of energies of protons temporarily trapped by this mechanism are calculated for various latitudes and distances. Several possible sources of charged particles and their contribution to the high intensity belts are discussed. The intensity due to the temporary capture of primary cosmic ray protons is calculated. The theoretical intensity curves are compared with the experimental curves taken aboard Pioneer III. The secondary albedo protons spectrum is deduced. Theoretical isointensity curves for captured primary and secondary protons are plotted for the distances from 2 to 8 earth radii. *Subject Headings:* **1. Van Allen belt 2. Magnetic effects on cosmic rays 3. Satellite cosmic ray measurements.**—*Authors' abstract.* Ⓢ

11.12–275 551.507.362.2:551.501.721

Gold, T. (*Harvard Coll. Observ., Cambridge, Mass.*), **Origin of the radiation near the earth discovered by means of satellites.** *Nature*, London, 183(4658):355–358, Feb. 7, **1959.** 2 figs., 7 refs. **DLC**—Explorer IV has added more information to the existing knowledge of the Van Allen radiation belt. Auroral observations and studies of the characteristics of the emitted charged particles, solar outbursts, magnetic storm clouds and other induced phenomena have been made. The sources of the variable magnetic storm disturbances and of the appearance of the aurorae are the instable flows of solar stream around the earth's field. These are discussed. *Subject Headings:* **1. U. S. Satellite 1958 Epsilon (Explorer IV) 2. Radiation measurement from satellites 3. Van Allen belt.**—*N.N.* Ⓢ

11.12–276 551.507.362.1:551.508.94:551.521.64

Hess, Wilmot N. (*Lawrence Radiation Lab., Univ. of Calif., Livermore, Calif.*) and Starnes, Arthur J. (*Air Force Special Weapons Center, Kirtland Air Force Base, Albuquerque, N. M.*), **Measurement of the neutron flux in space.** *Physical Review Letters*, N. Y., 5(2):48–50, July 15, **1960.** fig., 10 refs. **DLC**—A $B^{10}F_3$ neutron detector was flown on an Atlas rocket to an altitude of about 1400 km. The detector was mounted on a pod and was detached during the flight. The trajectory of the pod and the magnetic latitudes based on dip angles are shown.

The neutron detector count rate is plotted as a function of altitude. The fact that the neutron flux decreases with altitude (beyond 20 km) outside the atmosphere is in keeping with the thesis that the neutrons counted are from the earth. The increase of counting rate starting at 1000 km is undoubtedly due to penetration of the Van Allen radiation belt. Protons in the belt hit the pod and make neutrons some of which will be counted, thus causing increase in the count rate. *Subject Headings:* **1. Rocket instrumentation 2. Neutron counters 3. Van Allen belts.**—*E.Z.S.* Ⓢ

11.12–277 551.507.362.1:551.508.25:551.521.64

Holly, Francis E. and Johnson, Richard G., **Measurement of radiation in the lower Van Allen belt.** *Journal of Geophysical Research*, Wash., D. C., 65(2):771–772, Feb. **1960.** 2 figs. **DLC**—An instrument package of eight Geiger counters was released by an Atlas ICBM; its trajectory passed into the lower Van Allen belt. Some results are noted. The variation with altitude of peak counting rate in each counter is plotted and the differential spectrum of observed radiation obtained by subtraction of peak counting rates in successive counters is shown. *Subject Headings:* **1. Rocket radiation data 2. Geiger counters 3. Van Allen belts.**—*E.Z.S.* Ⓢ

11.12–278 551.521.64:061.3

Jastrow, Robert (*Nat'l Aeronautics Space Admin.*), **Scientists at Space Agency Seminar compare views on composition and origin of Van Allen radiation layer.** *Science*, Wash., D. C., 129(3355):1012–1013, April 17, **1959.** photo. **DLC**—The Van Allen radiation layer, discovered at the State University of Iowa and reported at the NAS meeting on 1 May, 1958 and later confirmed by the USSR Sputnik data, was a significant research achievement of the IGY satellite program. It has now provided an explanation of the aurora borealis and other geophysical phenomena. On 26 and 27 March, 1959, scientists at the Space Agency Seminar held a conference in order to compare views on the composition and origin of the Van Allen radiation layer as well as on the physical and theoretical problems associated with the layer. A full report is given in this paper. *Subject Headings:* **1. U. S. National Aeronautics and Space Administration 2. Van Allen belts.**—*N.N.* Ⓢ

11.12–279 551.521.64:523.72

Kellogg, Paul J. (*Univ. Minn., Minneapolis*), **Van Allen radiation of solar origin.** *Nature*, London, 183(4671):1295–1297, May 9, **1959.** fig., 7 refs., 6 eqs. **DLC**—Van Allen radiation originates from streams of solar particles trapped in the Earth's magnetic field. Possible sources of the inner radiation belt are neutron albedo, low-latitude auroral streams and high-altitude nuclear explosions. The gas is injected at a constant distance from the earth and undergoes a mechanical diffusion that is accelerated downward and upward. The intensity of the acceleration varies from the inner region to a maximum in the region beyond 4 Earth radii. The accelerated particles never came nearer the Earth than 1000 km. Possible reasons for the faster diffusion beyond a few Earth radii as well as the behavior of the accelerated particles are discussed. *Subject Headings:* **1. Solar atmosphere 2. Van Allen belts.**—*N.N.* Ⓢ

11.12–280 551.507.362.2:551.521.64

O'Brien, B. J. and Ludwig, George H. (*both, State Univ. of Iowa*), **Development of multiple radiation zones on Oct. 18, 1959.** *Journal of Geophysical Research*, Wash., D. C., 65(9):2695–2699, Sept. **1960.** 3 figs., table, 7 refs. **DLC**—Data from two Geiger counters on Explorer VII indicate that anomalous radiation zones developed around 1000 km altitude on the low latitude side of the outer radiation zone during a moderate magnetic storm on Oct. 18, 1959. The zones were first detected as quite separate regions of increased counting rates, each region about 0.5° thick in latitude. Later, other narrow zones were seen to be superimposed on a 6° thick zone of steadily increasing intensity. At one time, this broad zone contained radiation even more intense than that in the normal outer zone. The anomalous radiation disappeared within a few days as the outer zone returned to its prestorm condition. Correlation with ionospheric data indicates that much of the detected radiation was trapped for some hours at least. A qualitative explanation of the phenomena is suggested. *Subject Headings:* **1. Radiation zones 2. U. S. Satellite 1959 Iota (Explorer VII) 3. Van Allen belts.**—*Authors' abstract.* Ⓢ

11.12–281 551.521.64

Pikel'ner, S. B. (*Lomonosov Moscow State Univ.*), **The origin of the outer radiation belt of the Earth.** *Soviet Astronomy AJ*, New York, 3(6):1043–1044, May/June **1960.** 6 refs. **DLC.** Transl. of **K voprosu o proiskhozhdenii vneshnego radiatsionnogo poiasa Zemli.** *Astronomicheskiĭ Zhurnal*, Moscow, 36(6):1134, Nov./Dec. **1959. DLC**—The outer radiation belt of the Earth consists mainly of electrons with energies of several thousand ev, and higher. It has been supposed that their origin is connected with geoactive streams. One of the possible mechanisms of such a connection is proposed in this letter. *Subject Heading:* **1. Van Allen belts.**—*E.Z.S.* Ⓢ

11.12–282 551.521.64:550.385

Singer, S. Fred (*Dept. of Phys., Maryland Univ.*), **On the cause of the minimum in the earth's radiation belt.** Maryland Univ. Dept. of Physics, Contract AF 19(604)-3861, [Unnumbered Report], **1959.** 4 p. fig., table, 13 refs., 4 eqs. **DWB** (M21.32 S617on)—In an earlier work the hypothesis was advanced that if factors in addition to the density of the neutral component of the earth's outer atmosphere control the particle lifetime and therefore equilibrium intensity, then the intensity of the cosmic ray neutron radiation belt should fall off beyond a certain altitude with a maximum between 1 and 2 earth radii (R_E). Experimental results from space probes appear to have borne out this hypothesis, for two maxima were noted: 1.5 R_E and 3–4 R_E. A minimum intensity at about 2 R_E has been explained on the basis of other causes, e.g., instability of the earth's magnetic field at this location. These explanations, if correct, appear to eliminate the possibility of deriving atmospheric densities from measured radiation belt intensities. In order to choose from the various explanations, the expected altitude dependence of the cosmic-ray belt, incorporating in more detail the breakdown of the adiabatic condition, was calculated. The Alfven discriminant was used:—

$$x = \rho \text{ grad } B/B$$

where ρ = the particle's radius of curvature. x can also be written:

$$(m\beta c/B)(3M/r^4)(Mr^{-3})^{-1}\alpha\beta r^2$$

where $\beta = V/C$. M = earth's magnetic dipole moment. The assumption was made that the lifetime, and thus the intensity, is primarily determined by the atmospheric density for particles of small x. The differential directional concentration is defined and then the integral omnidirectional intensity is calculated. Using the relative distribution with altitude of neutral hydrogen in the earth's exosphere in the equation:

$$I = 6.8 \times 10^{-14} \bar{\eta} \cos d_c d\hat{e}^{-1} f \ (\beta \text{ max}, \beta \text{ min})$$

the intensity variation with altitude is graphed, showing a maximum at 1.5 R_E. This corresponds closely to the observations. The hypothesis that the adiabatic condition breaks down at higher altitudes can be easily verified experimentally since such a breakdown leads to a progressive diminution of β max according to the equation:

$$\beta \text{ max} = b/r^2.$$

This would lead to a progressive "softening" of the radiation in ascending to higher altitudes. *Subject Headings:* **1. Cosmic ray neutron intensities 2. Van Allen belts 3. Geomagnetic effects on cosmic rays.**—*A.J.M.* Ⓢ

11.12–283 551.507.362.2:551.510.535:551.594.12

Rosen, A.; Farley, T. A. and Sonett, C. P. (*all, Space Technology Labs., Inc.*), **Soft radiation measurements on Explorer VI earth satellite.** *International Geophysical Year*, 1957/1958. *IGY World Data Center A (for) Rockets and Satellites, IGY Satellite Report* No. 11:105–114, June **1960.** 8 figs., 7 refs. **DWB** (629.1388 I612sa)—The experiment reported in this paper was made to obtain direct observations of soft electrons in both the inner and outer Van Allen belts with a detector relatively insensitive to bremsstrahlung. The instrumentation details of the radiation detector, a cylindrical plastic scintillator are given and illustrated. The detector was carried by Explorer VI which was launched on Aug. 7, 1959. The data obtained

and their analysis are presented. The first few days show little solar or earth surface magnetic activity, and the electron intensity in the outer zone showed only small daily fluctuations. On Aug. 16 during a magnetic storm in the presence of solar activity, there was a large-scale depletion of particles, while gross fluctuations occurred in the electron intensity above 200 kev. After the storm large numbers of particles arrived to repopulate the outer zone while enhanced solar activity characterized by a large number of sunspots continued. *Subject Headings:* **1. U. S. Satellite 1958 Epsilon (Explorer IV) 2. Satellite ionospheric electron density measurements 3. Van Allen belt.**—*I.S.* Ⓢ

11.12–284 551.507.362.2:551.521.64:550.385.4

Rothwell, Pamela and McIlwain, Carl E. (*both, State Univ. of Iowa*), **Magnetic storms and the Van Allen radiation belts: observations from satellite 1958ε (Explorer IV).** *Journal of Geophysical Research*, Wash., D. C., 65(3):799–806, March **1960.** 4 figs., 2 tables, 16 refs. **DLC**—The changes in intensity of charged particles measured with two Geiger counters carried in Explorer IV, between 270 and 2200 km above the earth's surface in August and September 1958, have been analyzed. During magnetic storms marked decreases in the intensity of trapped charged particles were observed above about 1000 km, at the fringes of the outer Van Allen belt over North America and Australia; at lower altitudes, where little trapped radiation is usually observed, the Geiger counting rates increased underneath the outer zone at magnetically disturbed times. After the great magnetic storm of September 4–5, 1958, there was a significant increase in the average energy of particles trapped in the outer zone. No changes of intensity of particles in the inner Van Allen belt were detected during the period of observation except after nuclear explosions. It is suggested that the intensity decreases observed from Explorer IV in the outer radiation zone are due largely to increased scattering and absorption of trapped charged particles produced by atmospheric heating and expansion at fairly high latitudes during magnetic storms. The intensity increases observed at low altitudes beneath the outer zone are probably due to particles scattered down from the trapping region above. The average particle-energy increase in the outer Van Allen belt after a strong magnetic storm may be due either to injection of energetic particles from the sun into the trapping zone or to some acceleration process connected with the magnetic disturbance. The absence of noticeable intensity changes in the inner Van Allen belt argues in favor of a cosmic-ray albedo neutron rather than a solar origin of inner-zone protons, particularly since there was considerable solar activity during August and September 1958. *Subject Headings:* **1. U. S. Satellite 1958 Epsilon (Explorer IV) 2. Van Allen belts 3. Geomagnetic storm effects.** —*Authors' abstract.* Ⓢ

11.12–285 551.521.64

Snyder, Conway W. (*Jet Propulsion Lab., Calif. Inst. of Technology*), **The upper boundary of the Van Allen radiation belts.** *Nature*, London, 184 (4684), Supp. No. 7:439–440, Aug. 8, **1959.** fig., table, 7 refs. **DLC**—The author attempts to resolve the discrepancy on the intensity of the primary cosmic ray intensity beyond the earth's upper radiation belt as given by measurements with Pioneer III, Mechta (the Russian cosmic rocket) and Pioneer IV. The preliminary results of the Pioneer tests seemed to indicate a difference in cosmic ray intensity of almost a factor of 2. An analysis of the counting rate of Pioneer III is presented. On the basis of the fact that the upper boundary of the radiation belt as seen by Mechta was at a range of 55,000 km near the magnetic equator, that Pioneer IV detected numerous narrow peaks of radiation intensity between 47,000 and 91,000 km, but that the rapid drop in intensity beyond the main peak of the radiation appears to end at about 60,000 km and that the curve for Pioneer III is fairly accurately symmetrical about apogee between 40,000 and 60,000 km, it is concluded that the region of 9–10 earth radii is the boundary of the radiation belts. This accords well with the theoretical considerations of HOYLE and the magnetometer measurements of Pioneer I which place the upper boundary of the earth's magnetic dipole field in the same region. *Subject Headings:* **1. Cosmic ray intensities 2. Van Allen belts.**—*I.L.D.* Ⓢ

11.12–286 551.501.721:551.507.362.2:551.521.64

Van Allen, James A.; McIlwain, Carl, and Ludwig, George (*all, Iowa State Univ., Iowa City*), **Radiation measurements from Explorer IV.** *International Astronautical Congress,*

Amsterdam, Aug. 1958, Proceedings of the 9th Congress, Vol. 2:692 693, issued **1959. DLC** (TL787.144) –This report is based on data received from Explorer IV during its first two weeks in orbit. The instrumentation of the satellite included two small Geiger counters and two scintillation counters. These detectors confirmed the discovery that at altitudes greater than 1000 km a high intensity radiation is encountered. The flux of particles with ranges greater than 1 g/cm² has been measured to be approximately 3000 s/cm²/sterad at an altitude of 1900 km above the magnetic equator. At high latitudes the shorter range particles greatly predominate. Here the flux of particles with ranges greater than 0.14 g/cm² at 2200 km is about 100.000 s/cm²/sterad. A low energy component is usually present with the relative number of high energy particles increasing as the magnetic equator is approached. *Subject Headings:* **1. U. S. Satellite 1958 Epsilon (Explorer IV) 2. Satellite cosmic ray observation techniques 3. Van Allen belts.**—*E.K.* Ⓢ

11.12–287 551.507.362.2:551.521.64

Van Allen, James A. and Frank, Louis A. (*both, State Univ. of Iowa, Iowa City*), **Radiation around the earth to a radial distance of 107,400 km.** *Nature*, London, 183(4659):430–434, Feb. 14, **1959.** 5 figs., 9 refs., 9 eqs. **DLC**—The plot in a geomagnetic meridian plane of the intensity-structure of the radiation region around the earth as presented here, is based upon Pioneer III observations by means of a 302 and another 213 Geiger Müller tubes as basic detectors. The plot which surpasses earlier results harmonizes with the satellite 1958E observations. The discussion indicates that the outer zone is the one intimately related to usual high-latitude aurorae and it will not be surprising if solar activity is the governor of the entire structure. A pole-to-pole orbited satellite certainly would facilitate the plotting of the structure of the radiation region better and check its temporal changes. Another feasibility is the "vertical" probe outlined. *Subject Headings:* **1. Satellite cosmic ray data 2. Van Allen belts 3. U. S. space probe 1959 (Pioneer IV).**—*W.N.* Ⓢ

11.12–288 551.507.362.2:551.521.64

Van Allen, James A. and Frank, Louis (*both, State Univ. of Iowa*), **Van Allen radiation belt.** *American Geophysical Union, Transactions*, 40(1):75–78, March **1959.** 2 figs. **DWB**—Data resulting from the Pioneer III flight make additional contributions to the study of the radiation region. The counting rate data show the existence of two distinct, widely separated, high intensity zones within the region of trapped, corpuscular radiation surrounding the earth. The intensity level and the structure of the trapped radiation region may be strongly dependent on solar activity. Gross fluctuations may be expected over the eleven-year solar cycle. The two zones may originate in different ways. The counting rate declines at decreasing rate to 10 earth radii—approximate outer limit of trapped radiation; and decreases very gradually beyond 10 earth radii. The probe encountered no "blobs" of interplanetary plasma or the radiation in any blobs it may have met did not penetrate the Geiger-Müller tube walls. *Subject Headings:* **1. U. S. Satellites 2. Satellite radiation measurements 3. Van Allen belts.** —*E.Z.S.* Ⓢ

11.12–289 551.507.362.2:551.521.64

Van Allen, James A.; McIlwain, Carl E. and Ludwig, George H. (*all, Dept. of Physics, State Univ. of Iowa*), **Radiation observations with satellite 1958ε.** *Journal of Geophysical Research*, Wash., D. C., 64(3):271–286, March **1959.** 10 figs., 4 tables, 17 refs., 3 eqs. **DLC**—A preliminary account is given of the radiation observations made with Satellite 1958ε. The earlier discovery of the great radiation belt around the earth with Satellites 1958α and 1958γ has been confirmed and greatly extended with an apparatus of much greater dynamic range and discrimination. It appears likely that many important geophysical phenomena are intimately related to the reservoir of charged particles found to be trapped in the outer reaches of the earth's magnetic field. *Subject Headings:* **1. Satellite radiation measurements 2. Van Allen belts.**—*Authors' abstract.* Ⓢ

11.12–290 551.521.67:550.388:016

Van Allen, James A. (*State Univ. of Iowa*), **Geomagnetically-trapped corpuscular radiation.** *Royal Society of London, Proceedings, Ser. A*, 253(1275):525–529, Dec. 29, **1959.** 58 refs.

DWB, DLC—An up-to-date bibliography of works in the field of trapped radiation as a guide to the current status of the subject. *Subject Headings:* **1. Corpuscular radiation bibliographies 2. Van Allen belts.**—*E.K.* Ⓢ

11.12–291 551.521.64

Yagoda, Herman (*GRD, Air Res. & Development Command, L. G. Hanscom Field, Bedford, Mass.*), **Star production by trapped protons in the inner radiation belt.** *Physical Review Letters*, N. Y., 5(1):17–18, July 1, 1960. 2 figs., 6 refs. **DLC**—On July 21, 1959 an Atlas rocket fired from Cape Canaveral carried an 1800-gram block of Ilford G-5 emulsion to a peak elevation of 1176 km. The unit was recovered in good condition. It was noted that a large total star population was recorded greatly in excess over that anticipated by a brief exposure to cosmic radiation along an essentially equatorial trajectory, or that exhibited by ground control plates. The total prong count distribution of these stars, is compared with star spectra observed at balloon elevations by LORD (1951) at geomagnetic lat. 54°N and 28°N and with data from Viking rocket trajectories. The Atlas star spectrum differs from the others by a factor of about 100 in intensity and the slope of the *Nn* distribution indicates a large predominance of small stars. *Subject Heading:* **1. Van Allen belts.**—*E.Z.S.* Ⓢ

11.12–292 551.507.362.2:550.388:551.521.64

Yoshida, Sekiko; Ludwig, George H. and Van Allen, James A., **Distribution of trapped radiation in the geomagnetic field.** *Journal of Geophysical Research*, Wash., D. C., 65(3):807–813, March 1960. 5 figs., table, 11 refs. **DLC**—The altitude dependence (360 to 2090 km) of the intensity of geomagnetically trapped radiation as measured with Explorer I (satellite 1958α) is given for a number of geographic locations. It is found that all intensity data in the vicinity of the magnetic dip equator and over the full range of longitude and of altitude can be represented satisfactorily by a single function of the scalar magnetic field intensity B. The value of B at the lower boundary of the inner zone of trapped radiation is a monotonically increasing function of magnetic dip latitude; such data from all available geographic locations are well represented by a single curve. *Subject Headings:* **1. U. S. Satellite 1958 Alpha (Explorer I) 2. Van Allen belts.**—*Authors' abstract.* Ⓢ

4. GEOMAGNETISM

A. INSTRUMENTS

See also: **Signalling apparatus for magnetic storms** (Kalinowska-Widomska et al.), 11.12–312.

11.12–293 551.507.362.1:551.510.53:538.12

†Cahill, Laurence J., Jr., **Magnetic exploration of the upper atmosphere.** *International Geophysical Year, 1957/1958. IGY World Data Center A: Rockets and Satellites, IGY Rocket Report Series*, No. 4, Oct. 31, 1959. 86 p. 49 figs., 3 tables, 42 refs. **DWB** (M07.3621 161ro)—The State University of Iowa has developed a more reliable magnetometer to be used with small sounding rockets in the investigation of the ionospheric electrical currents suggested by VESTINE in 1947 to be measurable by rockets. The tests were made in the northern and southern auroral zones and near the geomagnetic equator. The results show the existence of polar, equatorial electrojet currents and the main magnetic field whose rate of decrease has been measured for comparison with that of the dipole field. The instrument is described in detail. *Subject Headings:* **1. Rocket magnetic measurements 2. Magnetometers 3. Equatorial electrojet.**—*N.N.* Ⓢ

11.12–294 550.380.8

Hurwitz, L. and Nelson, J. H. (*both, U. S. Coast and Geodetic Survey, Wash., D. C.*), **Proton vector magnetometer.** *Journal of Geophysical Research*, Wash., D. C., 65(6):1759–1765, June 1960. 3 figs., 2 tables, 8 refs., eqs. **DLC**—Z and H, as well as F, have been measured at the Fredericksburg Magnetic Observatory with a proton vector magnetometer, combining a proton-precission intensity magnetometer and a Helmholtz coil system mounted on a horizontal circle. Formulas for the effect of various instrumental adjustments are given

without proof; the only critical adjustment is the level of the horizontal circle (magnetometer base). The internal consistency of the observed values Zp, Fp, and Hp is indicated by the smallness of computed values $Hp-(Fp^2-Zp^2)^{\frac{1}{2}}$; these values are less than 3γ in magnitude and have a mean of 0.4γ. Preliminary results of comparisons with the observatory sine galvanometer and earth inductor are:

$$PVM-SG \text{ (measurements of } H)=2.7\gamma$$
$$PVM-EI \text{ (measurements of dip)}=1''.$$

The source of the H difference is now being investigated. *Subject Heading:* **1. Magnetometers.** —*Authors' abstract.* Ⓢ

11.12–295 550.380.8:539.12

Shapiro, I. R.; Stolarik, J. D. and Heppner, J. P. (*all, N. A. S. A., Wash., D. C.*), **The vector field proton magnetometer for IGY satellite ground stations.** *Journal of Geophysical Research*, Wash., D. C., 65(3):913–920, March **1960.** 4 figs., 6 refs., 3 eqs. Discussion by J. H. Nelson (*U. S. Coast and Geodet. Survey*), and (Reply by) Shapiro, Stolarik and Heppner, *ibid.*, 65(8):2551–2554, Aug. **1960.** table, 5 refs. **DLC**—By applying homogeneous bias fields to a proton precessional magnetometer, vector magnetic field measurements of exceptional accuracy can be obtained. A vector proton magnetometer that has been in operation at nine Minitrack stations since the spring of 1958 is described. *Subject Heading:* **1. Magnetometers.**—*Authors' abstract.* Ⓢ

11.12–296 551.507.362.1:550.380.8 551.510.53:550.388

†Sonett, C. P.; Judge, D. L.; Sims, A. R. and Kelso, J. M. (*all, Space Technology Lab., L. A., Calif.*), **A radial rocket survey of the distant geomagnetic field.** *Journal of Geophysical Research*, Wash., D. C., 65(1):55–68, Jan. **1960.** 17 figs., 22 refs., 5 eqs. **DWB, DLC**—A survey magnetometer carried aboard the Air Force Pioneer I space probe obtained data over the interval 3.7 to 7 and 12.3 to 14.8 geocentric radii. The day was unusually quiet magnetically ($A_p \sim 5$) with a long quiet prior history. The data indicate an inverse-cube-field decrease in the region of 3.7 to 13.6 radii, where termination takes place, with a subsequent decrease to 5×10^{-5} gauss. This value is examined in the light of possible interplanetary gas activity. The surprisingly distant geomagnetic cutoff suggests a very low gas pressure on the day of the flight. Increasingly large (fractionally) fluctuations were observed with increasing radii. A gross variability in the vestigial field would suggest hydromagnetic activity or a complex gas cloud structure. *Subject Headings:* **1. Rocket geomagnetic soundings 2. Magnetometers 3. Geomagnetic surveys.**—*Authors' abstract.* Ⓢ

11.12–297 551.507.362.2:550.380.8

Sonett, C. P.; Smith, E. J.; Judge, D. L. and Coleman, P. J., Jr. (*all, Space Tech. Lab., Los Angeles, Calif.*), **Current systems in the vestigial geomagnetic field: Explorer VI.** *Physical Review Letters*, N. Y., 4(4):161–163, Feb. 15, **1960.** 2 figs., 7 refs. **DLC**—Some preliminary data taken by the magnetometer carried by the satellite Explorer VI are presented. Representative preliminary data for orbital sweeps occurring on Aug. 10, Aug. 24, and Sept. 1, 1959 are discussed and graphically represented. These data indicate the existence of an extraterrestrial current system beyond 5 Re which causes a perturbation of the geomagnetic field. *Subject Headings:* **1. U. S. Satellite 1959 Delta (Explorer VI) 2. Satellite magnetic measurements 3. Earth's magnetic field.**—*I.S.* Ⓢ

11.12–298 550.380.8:550.385

Sauzade, Michel and Stefant, Robert, **Mesure des variations rapides du champ magnétique terrestre.** [Measurement of the quick changes of the earth's magnetic field.] *Académie des Sciences, Paris, Comptes rendus*, 248(23):3325–3327, June 8, **1959.** 3 figs., 3 refs. **DWB, DLC**—Description of an apparatus for the measurement of the quick changes of the Earth's magnetic field (up to 20 *Hz*); this instrument is composed of a capacitive counter-reaction photoelectric fluxmeter in which the inertia effect is considerably reduced and for which the response remains constant until about 50 *Hz*. The changes of the magnetic field

are detected by means of a sonde with ferrite core. Sensitivity of the instrument ranges about 1/20γ/mm. *Subject Headings:* **1. Geomagnetic field changes 2. Geomagnetic field instruments.**—*A. V.* Ⓢ

B. Variations, Disturbances

See also: **Indices of solar activity during IGY** (Bazzard), 11.12-45; **Current system of solar flare effects** (Veldkamp, van Sabben), 11.12 104; **Effect of solar eclipse on geomagnetic field and earth current** (Yamaguchi et al.), 11.12–125; **Magnetic effects from meteors** (Jenkins, Phillips), 11.12–163; **Cosmic ray and geomagnetic disturbances** (Bachelet), 11.12 212; **Storm-time increase of cosmic-ray intensity** (Yoshida, Wada), 11.12–225; **Van Allen radiation regions during geomagnetic storms** (Arnoldy et al.), 11.12 268; **Radio noise from upper atmosphere** (Section B5), 11.12 319 to 11.12–336; **Ionospheric-geomagnetic relationships** (Section B6h), 11.12–425 to 11.12–430.

11.12–299 550.385

WWA [World Warning Agency] decisions and geomagnetic disturbances Feb. 1–June 30, 1959. *American Geophysical Union, Transactions*, 40(4):388–389, Dec. **1959. DWB, DLC**—The report covers geomagnetic disturbances observed during Feb. 1–June 30, 1959. In Feb. and March geomagnetic disturbances generally were minor in intensity, exception was the geomagnetic storm, which began on March 26. Ten magnetic disturbances occurred during April–June. At the end of the report is a list of geomagnetic disturbances. *Subject Heading:* **1. Geomagnetic disturbances.**—*E.K.* Ⓢ

11.12–300 550.385.25

Onwumechilli, C. Agodi (*Dept. Phys. U. Coll. Ibadan, Nigeria*), **Lunar daily variation of the magnetic declination at Ibadan, Nigeria.** *Journal of Geophysical Research*, Wash., D. C., 65(10):3433–3435, Oct. **1960.** 2 figs., table, 5 refs. **DLC**—The data taken for 52 months at Ibadan are analyzed for lunar variation in geomagnetic declination (*D*). When grouped according to seasons, the results are found to be statistically significant for the June and December solstices but not for the equinox. There is almost a complete reversal of phase between the variations in the two solstices. It is found that the lunar variation in *D* at Ibadan does not show the marked effect of the equatorial electrojet so clearly observable in the variations of the horizontal force (*H*) and the vertical force (*Z*). Surprisingly, however the amplitude of variation in the summer is slightly smaller than that of the winter, but it is not yet clear how far this anomaly can be attributed to the electrojet. *Subject Headings:* **1. Geomagnetic declinations 2. Magnetic variations 3. Lunar diurnal magnetic variations 4. Ibadan, Nigeria.**—*Author's abstract.* Ⓢ

11.12–301 550.385.27

Onwumechilli, C. Agodi (*Physics Dept., Univ. College, Ibadan, Nigeria*), **A study of the equatorial electrojet, Pt. 1, An experimental study.** *Journal of Atmospheric and Terrestrial Physics*, London, 13(3/4):222–234, Feb. **1959.** 9 figs., 5 tables, 20 refs., eqs. **Pt. 2, A model electrojet that fits H-observation,** *Ibid.*, p. 235–257. 12 figs., 4 tables, 11 refs. **DLC** –An account is given of the photographic registration of the variation of the earth's horizontal magnetic force (*H*) across the magnetic equator in Nigeria from November 1956 to January 1957. As the period was magnetically quiet and the records were good, it has been possible to make a detailed study of the quiet day variation. The latitude of the maximum range of *H* was found to be about 0.5° from the magnetic towards the geographic equator. The daily variation curve of *H* is found to change its form as the magnetic equator is crossed from south to north and a method is introduced for the study of this change. It is shown that the fluctuations in *H*-variation curve characteristic of equatorial stations occur at the same time and in the same form at equatorial stations that may be distant from one another. The magnitudes of the same fluctuation at two stations are in about the same ratio as the daily ranges at the stations. It is thus likely that the indentations in the *H*-variation curve arise from fluctuations in the ionizing agent from the sun. In Pt. 2, methods are developed for separating the observed variation of the horizontal magnetic force (*H*) into its two component parts—the effect of the equatorial electrojet and the "normal variation" without the electrojet. It is shown

that in such a separation, it is necessary to allow for the possible phase difference between the two component parts. Theoretical curves from the electrojet regarded as a horizontal current band of uniform intensity are found to fit the experimental points reasonably well. The electrojet is found to have a height of from 100 to 125 km, a width of 4° latitude and the current intensity at the height of 100 km is 6700 A/degree latitude. The effect of the electrojet on the vertical component (Z) of the earth's magnetic field is found to have a maximum value at about 250 km from the jet. It is shown that after 600 km from the electrojet, the H-effect of the jet becomes very small whereas the Z-effect is large enough to explain the large Z-ranges observed in such regions. The geographical distribution of the forms of H-variation curve across the magnetic equator is explained as a result of the superposition of the "normal" variation and the electrojet effect. It is pointed out that Z-ranges observed at various parts of the world near the magnetic equator indicate a lack of symmetry about that equator, and this is explained with a theory developed in this paper. Some suggestions are given about the relative importance of the geographic, magnetic, and geomagnetic equators in geomagnetic variation. *Subject Headings:* **1. Equatorial electrojet 2. Earth's magnetic field 3. Geomagnetic variations.**—*Author's abstract.* Ⓢ

11.12–302 550.385.3:662.2:539.1

Mason, R. G. and Vitousek, M. K. (*both, Scripps Inst. La Jolla, California*), **Some geomagnetic phenomena associated with nuclear explosions.** *Nature*, London, 184(4688):52–54, Sept. 5, **1959.** 4 figs., 2 refs. **DWB**—During the IGY the Scripps Institution of Oceanography consistently recorded magnetic disturbances caused by the relatively low altitude nuclear explosions conducted by the British in the vicinity of Christmas Island. The disturbances had several features in common. The primary and secondary effects of these explosions are discussed; and a comparison of the British with the U. S. explosions in the Central Pacific is made. *Subject Headings:* **1. Geomagnetic disturbances 2. Nuclear explosion effects on geomagnetism.**—*N.N.* Ⓢ

11.12–303 550.385.37

Benoit, René and Tran, The Hien, **Etude du champ géomagnétique dans la bande 5–50 c/s.** [Study of the geomagnetic field in the band 5–50 c/s.] *Académie des Sciences, Paris, Comptes Rendus*, 250(5):893–895, Feb. 1, **1960.** 3 figs., 5 refs. **DWB, DLC**—Study of the rapid micropulsations of the terrestrial magnetic field based on measurements made in the region of Saigon. Brief description of the equipment used which takes up the electromagnetic signals through a screened frame of 1.50 m×1 m comprising 1700 helices, and connected by a coaxial to the amplifier which is constituted by 4 transistor stages. The impulses received greatly exceed the ground noise. Only local storms are recorded. Certain storms last for several hours, others for a few minutes. During the monsoon period, most of the intertropical zone is stormy and activity practically uninterrupted. It is recommended that the low frequencies of the atmospheric noise be recorded to separate the regional storms from the distant storms in the radiogoniometry of storm centers. *Subject Heading:* **1. Geomagnetic pulsations.**—*A. V.* Ⓢ

11.12–304 550.385.37

Briunelli, B. E.; Berdichevskiĭ, M. N., et al., **Nabliudeniia korotkoperiodicheskikh variatsiĭ elektromagnitnogo polia Zemli.** [Observations on short-period variations of the electromagnetic field of the earth.] *Akademiia Nauk SSSR, Izvestiia, Ser. Geofiz.*, No. 8:1206–1213, Aug. **1959.** 8 figs., 2 tables, 8 refs., 4 eqs. **DWB, DLC**—The magneto-telluric method of sounding of the earth's crust, proposed by H. N. Tikhonov and Kan'iar, is discussed on the basis of experimental observations of variations in the earth's electromagnetic field with intervals of 10–15 to 50 sec. The magnetometer equipment, method of observation and samples of graphic records are described in detail and results tabulated. The use of magneto-telluric profiling in geological surveying is found effective, confirming early theoretical considerations. Therefore an industrial development of this method of profiling is quite feasible. With this method and equipment a few magnetic storms were recorded. *Subject Headings:* **1. Electromagnetic field changes 2. Magnetic storms. I. Alekseev, A. M. II. Burdo, O. A.** —*N.P.S.* Ⓢ

11.12–305 550.385.37

Jacobs, J. A. (*Geophysics Lab., Univ. British Columbia*) and Sinno, K. (*Radio Res. Lab., Kokubunji, Japan*), **Occurrence frequency of geomagnetic micropulsations Pc.** *Journal of Geophysical Research*, Wash., D. C., 65(1):107–114, Jan. 1960. 16 figs., 2 tables, 22 refs., eq. **DWB, DLC**—An analysis of the occurrence frequency of geomagnetic micropulsations *Pc* has been carried out using data obtained during the IGY from a world-wide network of stations. From the characteristics of the diurnal occurrence frequency and their latitudinal and longitudinal dependence, the following conclusions are drawn: (1) The occurrence frequency of *Pc*'s increases as the auroral zones are approached from lower latitudes. Also the hour of the diurnal maximum occurrence appears earlier at high-latitude stations. (2) The occurrence frequency of *Pc*'s depends not only on local time but also in part on universal time. The universal-time factor affects the modulation of the diurnal occurrence by about 50%. The time of maximum occurrence of *Pc*'s is about 21 hours GMT in the northern hemisphere. In the southern hemisphere the universal-time factor has opposite phase to that in the northern hemisphere. When the universal-time factor is a maximum in the northern (or southern) hemisphere, the north (or south) geomagnetic pole is about 16 or 17 hours LMT. The GMT dependence derived in this investigation shows about 7 hours' difference compared with TROITSKAYA'S conclusion, which was based on data from several stations in the USSR. *Subject Heading:* **1. Geomagnetic micropulsations.**—*Authors' abstract.* Ⓢ

11.12–306 551.510.535:550.385.37

†*Kato, Yoshio (*Geoph. Inst. Tohoku Univ.*), **Investigation on the geomagnetic rapid pulsation.** *Tohoku Univ., Science Reports, 5th Ser., Geophysics*, Vol. 11, Supplement, Aug. 1959. 28 p. 19 figs., tables, 10 refs. At head of cover-title: I.G.Y. Report of Onagawa Magnetic Observatory, No. 1. **DWB, DLC**—The author discusses the nature of geomagnetic pulsations, surveying the observational and theoretical knowledge obtained during 1958–59 (since the I.G.Y. meeting of 1957 in Copenhagen). Data on outer atmosphere and geomagnetic pulsations with accompanying ssc and sfe, are presented with brief explanations. The results are as follows: 1) *Pg* pulsation is caused by the toroidal type hydromagnetic oscillation of the outer atmosphere, while *Pt* and *Pc* pulsations are of a poloidal type, which can be observed only in the auroral zone; 2) *Pc* pulsation is a standing oscillation at the lower boundary of the outer atmosphere excited by the corpuscular beam of lower energy that impinge on higher latitudes of the sunlit hemisphere. *Subject Headings:* **1. Geomagnetic micropulsations.**—*K.C.* Ⓢ

11.12–307 550.385.36/4:551.510.535:551.594.13

†Duncan, R. A. (*Camden, N. S. W., Australia*), **The cause of magnetic storms and bays.** *Journal of Geophysical Research*, Wash., D. C., 65(11):3589–3592, Nov. 1960. 3 figs., 20 refs. **DWB, DLC**—Because of the Hall effect, electric current will circulate anticlockwise around an area of proton precipitation and clockwise around an area of electron precipitation (in the northern hemisphere). This is suggested as the cause of the current systems of magnetic bays and storms. The observed geographical distribution of auroral hydrogen emission, polar blackout, and auroral E ionization is used to suggest that the required pattern of protons and electron precipitation occurs. *Subject Headings:* **1. Magnetic storm theories 2. Magnetic bay disturbances 3. Auroral ionization 4. Geomagnetic-ionospheric relationships.**—*Author's abstract.* Ⓢ

11.12–308 550.385.4:551.594.5

Piddington, J. H. [Radiophysics Division, C. S. I. R. O., Sydney], **A theory of polar geomagnetic storms.** *Geophysical Journal*, London, 3(3):314–332, Sept. 1960. 6 figs., 13 refs., 24 eqs. **DWB, DLC**—This is the third of a series of papers outlining a hydromagnetic theory of geomagnetic storms. The first two dealt with the storm-time variations *Dst* in terms of isotropically propagating hydromagnetic compression (first phase) and rarefaction (main phase) of the geomagnetic field and its plasma. The three phases of the longitude-dependent disturbance *Ds*, the first phase or *Sc*, the main phase and the preliminary reverse are all accounted for in terms of hydromagnetic waves whose Poynting fluxes are directed along the magnetic lines of force. These disturbances originate from "electromagnetic fric-

tion" between the solar wind and geomagnetic lines of force near 06 and 18 h local time. These lines of force are bent out of their meridian planes and cause two pairs of "twist" waves to reach the Earth, being focused into relatively confined regions at high latitudes. These twists are stable or force-free and result in space-charge accumulations in the lower ionosphere where the resultant Hall current accounts for the observed disturbances. During the main phase the twists are maintained by a deformation of the geomagnetic field which was described in the first two papers (the geomagnetic "tail"). Thus the tail theory accounts for both *Dst* and *Ds* main phase. It is difficult to see how any ring-current theory or other theory dependent on trapped corpuscular radiation could account for the asymmetric features of a storm. The mechanism also provides the beginning of a theory of aurorae. *Subject Heading:* **1. Magnetic storm theories.**—*Author's abstract.* Ⓢ

11.12–309 550.385.4

Yoshimatsu, Takasaburo, **A note on the distribution on Dst of the geomagnetic-north component.** *Kakioka, Japan. Magnetic Observatory, Memoirs,* 9(1):21–25, March **1959.** 4 figs., 5 tables, 15 refs. Japanese summary, p. 21. **DWB**—A discussion of basic characteristics of worldwide distribution of geomagnetic storms in the light of a series of results obtained from elaborate statistical works on their new mode of morphology (SUGIURA and CHAPMAN). According to these results the maximum depression of average Dst of the geomagnetic north component, which is measured from the pre-storm level, is distributed against the geomagnetic latitude. This relationship is mathematically illustrated and discussed in different given situations. *Subject Heading:* **1. Geomagnetic storms.**—*I.S.* Ⓢ

11.12–310 550.385.43:621.396.8

Ellis, G. R. A. (*C. S. I. R. O., Australia*), **Geomagnetic disturbances and 5 kilocycles per second electromagnetic radiation.** *Journal of Geophysical Research,* Wash., D. C., 65(6):1705–1710, June **1960.** 6 figs., 12 refs. **DLC**—A comparison is made between variations of the geomagnetic field and bursts of 5-kc/s radio noise recorded at Camden, N.S.W., between June 1958 and Oct. 1959. During this period 8 noise storms were recorded. All occurred during the main phase of a geomagnetic storm, beginning on the average 3 hours after the start of the main phase. Of 97 isolated noise bursts of less than 4 hours' duration, 43 were associated with positive bays in the record of the magnetic *H* component. No consistent delay between the noise burst and the bay was observed. Noise bursts were not in general associated with geomagnetic micropulsations of less than 1-minute period, although some correlation with quasi-sinusoidal magnetic variations with periods between 10 and 60 minutes was noted. During the period of the observations 30 magnetic sudden commencements were followed by noise bursts or storms after an average delay of 8.5 hours. On four occasions, a noise burst started immediately after a sudden commencement occurring between 1200 and 1800 hours GMT. *Subject Headings:* **1. Geomagnetic disturbances 2. Sudden commencements 3. Radio noise bursts.**—*Author's abstract.* Ⓢ

11.12–311 551.510.535:551.594.13:550.385.43

Troitskaia, V. A. and Mel'nikova, M. V., **O kharakternykh intervalakh kolebanii ubyvaiushchikh po periodu (10-1 sek.), v elektromagnitnom pole Zemli i ikh sviazi s iavleniiami v verkhneĭ atmosfere.** [Characteristic intervals of pulsations of diminishing periods (10-1 sec.) in the electromagnetic field of the earth and their connection with phenomena in the upper atmosphere.] *Akademiia Nauk SSSR, Doklady,* 128(5):917–920, **1959.** 3 figs., 3 refs. **DLC**—Characteristic intervals of periodically subsiding oscillations obtained on high speed records of terrestrial currents (½ mm/sec) during the course of analysis of the microstructure of magnetic storms according to short period oscillations are examined. Twenty-hour records of 17 Soviet stations were used. Graphs showing the patterns of the interval of periodically subsiding oscillations, the pattern of development and passage of the interval of these oscillations at different stations for a given magnetic storm and *f*-graphs of the condition of the ionosphere at the Moscow station in the case of two magnetic storms are presented. The analysis shows that the periodically subsiding oscillation is the characteristic morphological element of disturbance of the earth's magnetic field which is correlated directly with sudden disturbances in the ionosphere and with the development of auroras in low latitudes. *Subject*

Headings: **1. Magnetic pulsations 2. Magnetic effects on ionosphere 3. Auroral-geomagnetic relationships.**—*I.L.D.* Ⓢ

11.12–312 550.380.2(438) 550.385.87:550.385.4

Kalinowska-Widomska, Ewa; Marianiuk, Janusz and Gnoiński, Adam (*all, Świder Geophysical Obs.*), **Sygnalizator burz magnetycznych w Obserwatorium Geofizycznym w Świdrze.** [A signaling apparatus for magnetic storms at the Świder Geophysical Observatory.] *Przegląd Geofizyczny*, Warsaw, 4(3/4):171–177, **1959.** 6 figs., table. English summary p. 176–177. **DWB, DLC**—The apparatus, constructed by the authors, began operations at the Świder Geophysical Observatory during IGY. It keeps the observatory's staff continuously informed of the course of geomagnetic field variations, sounds an alarm at the beginning of disturbances with storm character. Circuit diagram of the alarm system is shown. Records of the milliammeter and magnetogram are shown. The correlation is sufficient to determine the character of the declination variations from the milliammeter record. *Subject Headings:* **1. Magnetic storm signal devices 2. Świder, Poland.**—*E.S.* Ⓢ

11.12–313 523.746:550.385.4

Mitropol'skaia, O. N. (*Crimean Astrophysical Obs., Academy of Sciences, USSR*), **Relation between the delay time of geomagnetic disturbances and the relative sunspot number.** *Soviet Astronomy AJ*, New York, 4(1):60–63, July/Aug. **1960.** 5 figs., 11 refs. **DLC.** Transl. of **Sviaz' vremeni zapazdyvaniia geomagnitnykh vozmushchenii s otnositel'nym chislom solnechnykh piaten.** *Astronomicheskii Zhurnal*, Moscow, 37(1):63–66, Jan./Feb. **1960. DLC**—Figures 1 and 2 of the present study show that the time delay Δt of a disturbance relative to the CMP of the plage depends on the sunspot numbers, rather than on the phase of solar activity. The divergence of the curves in the right part of Fig. 2 is due to the numbers R not being an adequate measure of the level of solar activity for the very minimum of activity (low R). Statistical curves (Fig. 3) are given for different intervals of R, based on plages of the periods 1929–1933, 1942–1944, and 1950–1953. The upper curve includes plages for the period April 1950–Dec. 1950; the second, Oct. 1929–Sept. 1930, April 1942–June 1942, June 1951–June 1952; the third, Oct. 1930–Dec. 1931, July 1942–June 1943, July 1952–Sept. 1953; the fourth, Jan. 1932–Sept. 1933, July 1943–March 1944, Oct. 1953–Dec. 1953. A curve (Fig. 4) is drawn for the interval $15 < R < 90$, based on data for Oct. 1929–Dec. 1931, April 1942–June 1943, June 1951–Sept. 1953. Notwithstanding the sharply defined left maximum for the periods 1929–1933 and 1942–1944 the second and third curves of Fig. 3, and the curve of Fig. 4 have almost no noticeable left maximum. The scheme was computed for the case when pairs of plages with different ΔL are present on the sun during a long period. At the same time, these curves contradict the hypothesis that there is a cone of avoidance. Figure 5 is based on Fig. 3, and gives the delay time of a disturbance Δt as a function of the number R. This figure can serve as a basis for the prediction of M-disturbances. *Subject Headings:* **1. Sunspot relative numbers 2. Geomagnetic disturbances 3. Sunspots and magnetic storms.**—*Author's abstract.* Ⓢ

c. Outer Magnetic Field

See also: **Solar-terrestrial relationships** (Cole), 11.12–127; **Cosmic-ray equator and geomagnetic dip equator** (Oguchi, Kodama), 11.12–219; **Analysis of primary cosmic ray intensity** (Engler et al.), 11.12–228; **Energetic particle fluxes** (Gold), 11.12–230; **Magnetic cutoff rigidities of charged particles** (Rothwell), 11.12–253; **Van Allen radiation belts** (Section B3), 11.12–267 to 11.12–292; **Rocket survey of distant geomagnetic field** (Sonett et al.), 11.12–296; **Spiral occurrence of sporadic-E** (Hagg et al.), 11.12–386; **Ray paths in ionosphere in the presence of earth's magnetic field** (Titheridge), 11.12–433.

11.12–314 662.2:539.1:551.510.536:550.388

The Argus experiment. *American Geophysical Union, Transactions*, 40(3):301–311, Sept. **1959.** 6 figs., table. **DWB**—Preliminary analyses of the data from the Argus detonations have confirmed the theory of trapping of radiation by the magnetic field of the earth and have supplied new information about the configuration and characteristics of the magnetic

field. Data gained by this experiment may also provide a better basis for understanding the mechanics of natural trapping in the Van Allen region and of related phenomena such as the aurora. *Subject Headings:* **1. Argus Experiment 2. Magnetic field 3. Van Allen belts.** —*E.Z.S.* Ⓢ

11.12–315 523.388:550.380.8

Coleman, P. J., Jr. (*Space Tech. Lab., Inc., Los Angeles*); Davis, Leverett (*Calif. Inst. of Tech., Pasadena, Calif.*) and Sonett, C. P. (*Space Tech. Lab., Inc., Los Angeles*); **Steady component of the interplanetary magnetic field: Pioneer V.** *Physical Review Letters*, N. Y., 5(2):43–46, July 15, **1960.** 2 figs., 15 refs. **DLC**—This paper reports some of the observations made with the magnetometer carried aboard Pioneer V. The data for the first 50 days of operation have been examined. These data include measurement in the distant field of the earth, the geomagnetic boundary, and interplanetary space. The subject of this note concerns, specifically, an apparent steady component of the interplanetary magnetic field. The average maximum and minimum magnetometer data are plotted for 11 March to 30 April 1960. There are serious discrepancies between the implications of the observations and present models of the interplanetary field. *Subject Headings:* **1. Interplanetary magnetic field 2. Satellite magnetic measurements.**—*E.Z.S.* Ⓢ

11.12–316 551.507.362.1:550.388.6

Dolginov, S. Sh. and Pushkov, N. V., **Rezul'taty izmereniia magnitnogo polia Zemli na kosmicheskoĭ rakete.** [Some results obtained by measuring the magnetic field of the Earth with a space rocket.] *Akademiia Nauk SSSR, Doklady*, 129(1):77–80, **1959.** 2 figs., 5 refs. **DLC.** Transl. into English issued by U. S. Joint Publications Research Service as its JPRS, L-1981-D, Jan. 8, **1960.** Transl. available OTS as its 60-31-013. Price $0.50.—The cosmic rocket of Jan. 2, 1959 measured the magnetic field of the Earth at a distance of several Earth radii from the center of the Earth. Measurements were made with a magnetometer having elements of the magnetically saturated type. The range of measurement for each element was $\pm 3000\gamma$. The departure of the magnetometer from zero did not exceed 20γ in 24 hours of continuous operation. A comparison of the variation of measurements of the magnetic field with distance from the Earth as measured by the rocket with variations of the magnetic field calculated by a formula that expands the terrestrial magnetic field into a series of spherical functions showed that at a distance of the rocket of 14.7×10^3 to 30×10^3 km the measured values differed considerably from the computed ones. Hence at a distance of 2–5 earth radii the magnetic field is determined not only by values computed from the Earth's magnetic potential but also by external sources. A comparison of measured and computed variations of the magnetic field with distance from the Earth with rocket measurements of the intensity of cosmic radiation indicated that the effects observed in the measured magnetic field are the results of superposition of the magnetic field of the corpuscular zone upon the internal magnetic field of the Earth. The most probable cause of the magnetism of corpuscular zones is currents arising as a result of the drift of particles in the nonhomogeneous magnetic field of the earth. These currents may flow along the geomagnetic directions from east to west. The lines of flow diminish the Earth's magnetic field in the space turned to the Earth and increase it in the opposite part. Hence the observed anomalies of part of the magnetic field are determined principally by the variation of the density of currents associated with variations of density of energy and by variations of the position of the rocket in relation to the maximum density of flux. *Subject Headings:* **1. Rocket magnetic measurements 2. Magnetic field measurement techniques 3. Magnetometers.**—*I.L.D.* Ⓢ

11.12–317 523.388 551.507.362.2:551.594.13:551.594.51

Smith, E. J.; Coleman, P. J.; Judge, D. L. et al. (*all, Space Technology Labs., Calif.*), **Characteristics of the extraterrestrial current system: Explorer VI and Pioneer V.** *Journal of Geophysical Research*, Wash., D. C., 65(6):1858–1861, June **1960.** 5 figs., 6 refs. **DLC**—A ring current model is set up analogous to the suggestion by STÖRMER (1911). Close agreement between the model and the similarity of the values of the parameters in the two regions of space strongly suggest the existence of a ring current around the earth at altitudes of approximately 10 earth radii. *Subject Headings:* **1. U. S. Satellite 1958 Epsilon (Explorer IV)**

2. U. S. Satellite 1960 Alpha (Pioneer V) 3. Ring currents 4. Störmer ring. I. Sonett, C. P. —*E.Z.S.* Ⓢ

11.12–318 551.510.53:550.388

Vestine, E. H. (*Rand Corp., Calif.*), **The survey of the geomagnetic field in space.** *American Geophysical Union, Transactions*, 41(1):4–21, March **1960.** 11 figs., 4 tables, 21 refs., 4 eqs. **DWB, DLC**—A paper, extensively illustrated by maps, graphical representations and tables, presenting a survey of the geomagnetic field near the Earth and in the surrounding space. The organization of the paper consists of a description of geomagnetic measurements, early surveys and theory, and later surveys of the Earth's main field, a discussion of airborne magnetometer surveys over the oceans, world magnetic charts of the Earth's main field and its secular change, analysis of the main field, magnetic surveys by Earth satellite, the problem of magnetic secular change and technical recommendations of existing committees. *Subject Headings:* **1. Geomagnetic field 2. Upper atmosphere.**—*I.S.* Ⓢ

5. RADIO NOISE FROM UPPER ATMOSPHERE, WHISTLERS

See also: **Synchrotron radiation from Van Allen belts** (Dyce, Nakada), 11.12–272; **Geomagnetic field in 5–50 c/s band** (Benoit, Tran), 11.12 303; **Geomagnetic disturbances and 5 kc/s radiation** (Ellis), 11.12–310; **Exosphere and upper F region** (Johnson), 11.12–400.

11.12–319 551.510.53:551.594.12:621.384.6

Murcray, W. B. and Pope, J. H. (*both, Geophysical Inst., U. of Alaska, College, Alaska*), **Doppler-shifted cyclotron frequency radiation from protons in the exosphere.** *Physical Review Letters*, N. Y., 4(1):5–6, Jan. **1960.** 2 figs., 2 refs. **DLC**—This paper investigates in detail a suggestion by T. W. MacArthur, in a recent publication, that the phenomenon known as "Dawn chorus" may be due to Doppler-shifted radiation from protons which are rotating about the lines of force of the earth's magnetic field with the cyclotron frequency: $v_c = 1.54 \times 10^3 B$, where B is the field strength in gauss. Theoretical chorus dispersion curve and audio spectrogram of chorus illustrate the discussion. *Subject Heading:* **1. Dawn chorus.**—*I.S.* Ⓢ

11.12–320 551.510.536:621.396.8

Ellis, G. R. A. and Cartwright, D. G. (*both, Commonwealth Scien. & Indust. Res. Organiz., New So. Wales*), **Directional observations of radio noise from the outer atmosphere.** *Nature*, London, 184 (4695, Supp. No. 17):1307–1308, Oct. 24, **1959.** fig., table. **DWB**—Observations made on the radio emission of the Earth's outer atmosphere in the frequency band of 2–40 Kc/s by a newly developed technique for continuously monitoring the occurrence of such phenomena are described. The bursts of low frequency noise have a relatively narrow spectrum. Their likely mechanism is described. It appears possible to estimate the size of the virtual sources of very low frequency radiation. *Subject Headings:* **1. Outer atmosphere 2. Radio noise bursts 3. VLF radio wave propagation.**—*A.H.K.* Ⓢ

11.12–321 551.510.536:621.396.8

Ellis, G. R. A., Cartwright, D. G. and Groves, J. R. V., **Spaced observations of radio noise from the outer atmosphere.** *Nature*, London, 184(4696 Supp. No. 18):1391–1392, Oct. 31, **1959.** fig., ref. **DWB**—It was suggested by G. R. A. Eliss in *Planetary and Space Science* that during some types of radio noise storms in the Earth's outer atmosphere, the source of noise may remain in constant position in right ascension. In this case the arrival of the storm will be recorded at the same local time at places of different longitude rather than simultaneously. In a majority of the cases noise bursts were recorded simultaneously at Camden and Adelaid. A distinct time delay was observed only during a major geomagnetic storm and aurora. *Subject Heading:* **1. Radio noise from outer atmosphere.**—*A.H.J.* Ⓢ

11.12–322 551.510.536:550.385:621.396.8

Ellis, G. R. A. (*C. S. I. R. O., Camden, Australia*), **Directional observations of 5 kc/s radiation from the earth's outer atmosphere.** *Journal of Geophysical Research*, Wash., D. C., 65(3):839–843, March **1960.** 3 figs., 2 tables, 5 refs. **DLC**—Low-frequency radio noise

bursts associated with geomagnetic disturbances have been observed with a network of direction-finding receivers in southeastern Australia during September and October 1959. Over a range of longitudes from 135°E to 155°E, 18 noise bursts came from apparent sources at latitudes greater than 42°S. On 8 occasions, isolated, discrete noise sources with an average geographical size of 550 km were detected at latitudes between 34°S and 42°S. *Subject Headings:* **1. Outer atmosphere 2. Radio noise bursts 3. Geomagnetic disturbance effects 4. Australia.**—*Author's abstract.* Ⓢ

11.12–323 551.510.535:621.396.8

Pawsey, J. L., **The question of radio emission by the ionosphere.** *Journal of Atmospheric and Terrestrial Physics*, London, 15(1/2):51–53, Sept. **1959.** 10 refs. **DLC**—The importance of non-thermal emission of radio waves of the ionosphere as a probable source of "radio noise from the aurora" in ionospheric and astronomical studies is examined. The thermal emission from the D region does not preclude occasional bursts nor intense emission from the E layer. Intense noise from all over the sky reported on meter wavelengths, and other similar reports, until reliably reproduced, present clues rather than evidence. Brief increases of noise level on a frequency of 33 Mc/s coinciding with meteors might originate from a source other than the meteor. GALLET's report giving reasons for supposing the "dawn chorus" is generated in the outer reaches of the ionosphere, is worthy of further examination. *Subject Headings:* **1. Radio emission from ionosphere 2. Radio noise.**—*O.T.* Ⓢ

11.12–324 621.396.8:550

Gustafsson, Georg; Egeland, Alv and Aarons, Jules, **Audio-frequency electromagnetic radiation in the auroral zone.** *Journal of Geophysical Research*, Wash., D. C., 65(9):2749–2758, Sept. **1960.** 9 figs., table, 18 refs. **DLC**—During three one-month periods, continuous spectograms of the electromagnetic energy in the spectral region between 10 cps and 10 kc/sec were recorded in Kiruna, Sweden. The records were examined from the viewpoint of background energy. Throughout the entire frequency band studied, there is a low daytime signal level and a nighttime maximum. The ratio of the maximum to minimum amplitude varies as a function of frequency (the higher maximum-to-minimum ratio occurs at the lower frequency range of 20 to 200 cps) and with the season of the year. It is concluded that the daytime ionosphere absorbs the energy throughout the entire spectrum studied. It was found that, although strong deviations of the signal level from the normal were often associated with geomagnetic disturbances, there was a general lack of correlation between magnetic index and low-frequency noise, except in the 10 to 45-cps frequency range. The origin of the background signals is probably two-fold, atmospherics from great distances as well as magnetic and exospheric fluctuations contributing to the lower band. On eleven occasions, electromagnetic radiation associated with micropulsations of the earth's magnetic field was detected. Two frequency bands were identified: one centered at 750 cps, which is the gyro frequency for protons at an altitude of 100 km above Kiruna; and the other ranging between 1.8 and 4.5 kc/s, which has been identified as his. On all but one of the occasions when emissions were detected, the 750-cps signals were quite stable in frequency. During four of the longest periods when radiation was recorded, the low-frequency emissions were received between two phases of a magnetic storm; micropulsations were simultaneously evident on the Kiruna magnetograms. *Subject Headings:* **1. Radar noise variations 2. Geomagnetic-radio noise relationships 3. Kituna, Sweden.**—*Authors' abstract.* Ⓢ

11.12–325 551.594.6:621.396.029.6

Gallet, R. M.; Richardson, J. M.; Wieder, B. et al. (*all, Boulder Lab., National Bureau of Standards, Colo.*), **Microwave whistler mode propagation in a dense laboratory plasma.** *Physical Review Letters*, N. Y., 4(7):347–349, April 1, **1960.** 3 figs., 6 refs., 4 eqs. **DLC**—The Atomic Energy Research Establishment, at Harwell invited the American authors to make their experiments on ZETA. Propagation in the Whistler mode near 3000 Mc/sec for $WII/W=Z$ was observed between cross-polarized short electric dipole antennas over paths up to 24 cm along the ZETA torus axis, as shown in figure, where H_0 is expected to be axial. An example of the received signal is shown. It is cut off at the onset of ionization as W_p becomes greater than W; it remains absent until the mode opens by virtue of the gyro fre-

quency exceeding the applied frequency; then a saturated signal is recorded until the mode closes. With the transmitter off, there is no signal greater than the noise level, for this discharge condition in which the current decays smoothly. Other measurements are in progress. *Subject Headings:* **1. Whistlers 2. Microwave propagation studies. I. Ward, G. D. II. Harding, G. N.**—*E.Z.S.* Ⓢ

11.12–326 551.594.12:551.594.6

Smith, R. L.; Helliwell, R. A. and Yabroff, I. W., **A theory of trapping of whistlers in field-aligned columns of enhanced ionization.** *Journal of Geophysical Research*, Wash., D. C., 65(3):815–823, March **1960.** 8 figs., table, 15 refs., 11 eqs. **DLC**—A ray theory of whistler propagation in ducts is developed for the purpose of explaining discrete whistler components. By use of refractive index surfaces and a Snell's law construction, it is shown that the only feature of the electron distribution affecting the trapping conditions is the ratio of the electron density in the column to that of the background. In most practical cases the electron density in the column required for trapping must be greater than the background level. Under certain conditions, however, the density in the column must be less than the background level. Using the theory, it is found that the enhancement required for trapping increases markedly toward the equator, providing a possible explanation for reduced whistler occurrence at the lower latitudes. *Subject Heading:* **1. Whistler propagation.**—*Authors' abstract.* Ⓢ

11.12–327 551.594.6:551.510.535

Dowden, R. L. and Goldstone, G. T. (*both, Commonwealth Ionospheric Prediction Serv., Hobart, Tasmania*), **"Whistler mode" echoes remote from the conjugate point.** *Nature*, London, 183(4658):385–386, Feb. **7, 1959.** fig., 3 refs., 2 eqs. **DLC**—An investigation, sponsored by the Australian National Committee of the I.G.Y. has been made of the Eckersley-Storey theory on whistler propagation. This theory predicts that whistler mode signals from Tokyo (20°N geomagnetic latitude) would return to the Earth's surface at a point near Darwin in the Northern Territory, some 3500 km from Hobart, Tasmania, (51°S geomagnetic latitude). Yet when echoes of very low frequency radio signals were established on 17.44 kc/s in Tokyo with delays of approximately 0.2 s they were later detected at Hobart. It is suspected that the echoes must have traveled via the whistler mode from Tokyo to the vicinity of Darwin and thence to Hobart through the Earth-ionosphere wave guide mode. Details are discussed. *Subject Headings:* **1. Whistlers 2. Ionospheric radio wave propagation.**—*N.N.* Ⓢ

11.12–328 551.594.6:621.396.8:551.510.536:551.594.12

Smith, R. L. and Helliwell, R. A. (*both, Stanford Univ.*), **Electron densities to 5 earth radii deduced from nose whistlers.** (*Summary only.*) *Journal of Geophysical Research*, Wash., D. C., 65(9):2583, Sept. **1960.** fig. **DLC**—Whistlers appear to propagate in columns of enhanced ionization aligned with the earth's magnetic field. From nose whistlers a value of 100 electrons/cm³ is calculated at 3 earth radii. *Subject Headings:* **1. Nose whistlers 2. Ionospheric electron density.**—*Authors' abstract.* Ⓢ

11.12–329 551.594.6:550.385

Kimpara, Atsushi (*Research Inst. Atmospherics, Nagoya Univ.*), **Correlation of occurrence of whistlers with geomagnetic activities.** *Nature*, London, 186(4720):230, April 16, **1960.** fig., table. **DWB**—It may be deduced that the frequency of occurrences of whistlers has a definite seasonal variation depending on thunderstorm activities, distribution of electron density and geomagnetic intensity in the exosphere and in the ionosphere due to solar activities and other, yet unknown, cosmic phenomena. Whistlers occur most frequently on the day which lags two days after geomagnetic disturbances in winter. It is difficult to find a single law applicable both to winter and to summer. *Subject Headings:* **1. Whistlers 2. Geomagnetic disturbance effects.**—*E.Z.S.* Ⓢ

11.12–330 551.594.6:550.386

Pope, Joseph H., **An investigation of whistlers and chorus at high latitudes.** Alaska. University. Geophysical Institute, Contract AF 19(604)-1859, Scientific Report, No. 4, April **1959.** 38 p. 18 figs., table, 10 refs.—The whistlers and chorus received at College,

Alaska during the period from December 1955 through March 1958 are studied particularly with respect to temporal variations. The diurnal curves for whistler activity show maxima after midnight local time while the seasonal variation peaks during the winter. It appears that these variations in whistler activity are in part explainable in terms of very low frequency propagation conditions. The diurnal variation of chorus shows a maximum at about 1400 hours local time. By the use of data from lower latitude stations a dependence of this time of diurnal maximum on the geomagnetic latitude of the station is shown. The coefficients of correlation for chorus activity versus magnetic activity were determined on a monthly basis. A seasonal variation in these correlations is indicated which appears to be unique for the geomagnetic latitude of College. A preliminary statistical study of one of the more easily measured characteristics of chorus is discussed. The characteristic chosen is the mid-frequency in an element of chorus. A diurnal variation in this parameter is indicated. *Subject Headings:* **1. Whistler variations 2. Whistler chorus activity 3. College, Alaska.**—*Author's abstract.* Ⓢ

11.12–331 551.594.6:551.581

Pope, Joseph H. (*Geophys. Inst. College, Alaska*), **Effect of latitude on the diurnal maximum of 'dawn chorus.'** *Nature*, London, 185(4706):87–88, Jan. 9, **1960.** 2 figs., table, 6 refs. **DWB**—Allcock and Pope have shown diurnal maxima as a function of geomagnetic latitude. The observations from a large number of stations with a time resolution of 1 hr. during IGY makes it desirable to reconsider the latitude effect. Our results indicate that it is desirable to consider the use of the eccentric dipole field in connection with theories of chorus. Also, the paths of whistler propagation may be affected by the eccentric field rather than the centered field, which may be an important consideration from the point of view of conjugate point experiments and electron density computations. *Subject Headings:* **1. Dawn chorus 2. Whistler propagation.**—*E.Z.S.* Ⓢ

11.12–332 551.594.6:523.164.32

Gerson, N. C. (*Arctic Committee, USNC for IGY*) and Gossard, W. H. (*U. S. Dept. of Defence*), **Sweepers.** *Journal of Atmospheric and Terrestrial Physics*, London, 17(1/2):82–85, Dec. **1959.** 2 figs., table, eq. **Comment by J. M. Watts,** *ibid.*, 18(1):81, April **1960. DWB, DLC**—In studying whistlers recorded at Palo Alto, Calif. it was found that most atmospherics in the hf band sweep through a finite frequency interval from high to low frequencies although some run from low to high frequencies. The source is possibly the sun (solar bursts of type II or type III). Those at night may be trapped in ionosphere. These have been named "sweepers." Various types of sweeper activity are shown graphically, covering most of the frequency spectrum from 2 to 30 Mc/s and possibly at lower or higher frequency. These types are normal or decreasing frequency, reverse (increasing frequency); fast (change $\geqslant$500 kc/s^2), slow ($<$25 kc/s^2) and irregular. Those observed on mornings of Nov. 11–14, 1958 and March 13, 1959 are shown graphically. Peak occurrence is at 24.0 Mc/s and majority from 23–265 Mc/s. Many sweepers occur in trains with intervals between 4 to 140 sec. A diurnal variation was found in rate of occurrence and distribution of sweepers by frequency. At the lowest frequencies sweepers may be identified with whistlers. *Subject Headings:* **1. Sweepers 2. Whistler research 3. Solar bursts 4. Palo Alto, Calif.**—*M.R.* Ⓢ

11.12–333 551.594.6:621.396.8

Pope, Joseph H. and Campbell, W. H. (*both, Univ. Alaska*), **Observations of unique VLF emission.** *Journal of Geophysical Research*, Wash., D. C., 65(8):2543–2544, Aug. **1960.** 3 figs., 3 refs. **DLC**—Describes an unusual natural electromagnetic disturbance in the VLF range received at a low noise site (63°43′N, 148°30′W) near College, Alaska. Sonagrams are shown. As the sound reminded the observers of ocean breakers the name surf is suggested. Surf phenomenon is difficult to understand in terms of the present state of knowledge and cannot be explained by the whistler echo type of propagation. Surface exhibits systematic behavior and is distinctive. *Subject Heading:* **1. Radio noise.**—*E.Z.S.* Ⓢ

11.12–334 551.501.83:621.396.8

Entzian, G., and Popp, C., **Lokalisierung von Initialsferics langer Whistler.** [Location of initial sferics in long whistlers.] *Zeitschrift für Meteorologie*, 13(7/8):193–194, July/Aug.

1959. 3 figs., 2 refs. **DWB, DLC**—An analysis of the location of initial sferics of long whistlers during the Fourth North Atlantic Expedition of the Soviet exploration vessel "Mikhail Lomonsov" is presented. The method of the analysis is described and illustrated. It was observed that more distant sferics usually produce weaker whistlers while closer sferics produce stronger ones. *Subject Headings:* **1. Sferics location 2. Whistlers.**—*O.T.* Ⓢ

11.12–335 621.396.8:551.510.535:551.594.6

Taylor, William L., **Daytime attenuation rates in the very low frequency band using atmospherics.** *U. S. National Bureau of Standards, Journal of Research, Sec. D*, 64(4):349–355, July/Aug. 1960. 12 figs., 20 refs., 7 eqs. **DWB, DLC**—Daytime attenuation characteristics have been computed by comparing the amplitude spectra of atmospheric waveforms recorded at four widely separated stations. The results of these attenuation measurements are presented for the band of frequencies from 3 to 30 kilocycles per second and involving distances of 1000 to 10,000 km. It was found from these data that attenuation was about 7 to 9 db per 1000 km at 8 kc/s and decreases to about 1 to 3 db per 1000 km at frequencies greater than 10 kc/s. The difference in attenuation rate of west-to-east propagation relative to east-to-west propagation was about 3 db per 1000 km less for frequencies lower than 8 kc/s and about 1 db per 1000 km less from frequencies higher than 10 kc/s. *Subject Headings:* **1. Radio wave attenuation 2. VLF radio wave propagation 3. Sferics propagation 4. Ionospheric radiowave propagation.**—*Author's abstract.* Ⓢ

11.12–336 551.501.83:551.594.221:551.510.62

Sao, Kazuo, **Numerical calculations of received night-time atmospheric pulse waveforms assuming the waveform radiated from a lightning stroke and the ionospheric reflection coefficient.** *Nagoya. Univ. Research Institute of Atmospherics, Proceedings*, 6:17–21, Jan. 1959. 7 figs., table, 6 eqs. **DWB**—The purpose of the present paper is to give a more detailed account of reflection type atmospheric waveforms on the basis of the ray theory. The author tried to calculate individual pulse waveforms numerically assuming the waveform radiated from a lightning stroke and the ionospheric reflection coefficient. Since numerical calculations are quite tedious to give, only a few pulse waveforms are presented, and the results indicate that computed pulse shapes change, in general, from an original waveform to more distorted waveforms. The results suggested here seem to explain the properties of reflection type atmospheric waveforms. *Subject Headings:* **1. Sferics wave forms 2. Sferics from lightning 3. Sferics reflection from ionosphere.**—*Author's abstract.* Ⓢ

6. IONOSPHERE

A. General

See also: **Results from space probe Pioneer V** (Fan et al.), 11.12–99; **Induction drag on satellite in ionosphere** (Wyatt), 11.12–534; **Wake of satellite traversing the ionosphere** (Rand), 11.12–535; **Damping of satellite wake in ionosphere** (Rand), 11.12–536; **Penetration of charged particles into ionosphere** (Pletnev), 11.12–581.

11.12–337 551.510.535:001.4

Silberstein, R. (*Nat. Bur. of Standards, Boulder, Colo.*), **The origin of the current nomenclature for the ionospheric layers.** *Journal of Atmospheric and Terrestrial Physics*, London, 13(3/4):382, Feb. 1959. **DLC**—A letter of Sir Edward Appleton answering J. H. Dellinger's questions, dated Feb. 13, 1943, is presented as a document on the origin of the nomenclature D, E and F for the ionospheric layers. *Subject Headings:* **1. Ionospheric layers 2. Nomenclature.**—*O.T.* Ⓢ

11.12–338 551.510.535:551.594.12

Wright, J. W. (*Natl. Bur. of Standards, Boulder, Colo.*), **Note on quiet-day vertical cross sections of the ionosphere along 75°W geographic meridian.** *Journal of Geophysical Research*, Wash., D. C., 64(10):1631–1634, Oct. 1959. 3 figs., 5 refs. **DLC**—The program of the Na-

tional Bureau of Standards to reduce hourly ionospheric soundings to electron density profiles, and to carry out a study of ionospheric morphology along the 75°W meridian, is described. Stations at Ft. Monmouth, N. J., Grand Bahama Island; St. Johns, New Foundland; and Puerto Rico, are preparing hourly virtual height data. The calculations give the heights of reflection at 60 closely spaced frequencies which provide the electron densities at each 10 km of height above 100 km. The height of peak density and the electron content of each 10 km level will be determined also. Some results are shown, including the penetration frequency for a magnetically quiet day in September 1957 and ionospheric structure in Panama on Sept 10, 1959. The equatorial "bulge" or great thickness of the ionosphere over the geomagnetic equator and the region of intense ionization at about 17° of the geomagnetic equator are apparent. A quantitative investigation of these two features is under study at Boulder Laboratories, Colorado. *Subject Headings:* **1. Latitude ionospheric variations 2. Equatorial ionosphere.**—*O.T.* Ⓢ

11.12–339 551.510.535:621.396.8

†*Finney, J. W. and Smith, E. K., Jr., **Report on the IGY oblique-incidence sporadic-E and F-scatter program.** *U. S. National Bureau of Standards, Technical Note,* No. 48, March **1960.** 94 p. 25 figs., numerous tables, 4 refs., eqs. (Final Report on NSF Grant Y/6.14/120; First Technical Report NSF Grant Y/22.7/328.) **DWB**—The existence of the longitude effect in the occurrence of sporadic-E propagation suggested by previous data has been affirmed by the experiment described here, inasmuch as three to five times more sporadic-E has been observed on the Poro-to-Onna circuit in the Far East than on the Panama-to-Cuba circuit. Seasonal and diurnal variations are noted. Peculiar evening signal enhancements were observed, around the fall equinox, over the Poro-to-Onna circuit. Pulse measurements show time delays pertinent to F-region reflection; pulse broadening points toward a scatter rather than a specular reflection mechanism for these signals. Only faint evidence of a similar phenomenon was found in Caribbean area. The experimental arrangements are described and the data derived are presented. The receiver calibrations are appended and a bibliography included. *Subject Headings:* **1. Sporadic E layer (Es) scattering 2. F layer scattering 3. IGY programs.**—*E.Z.S.* Ⓢ

11.12–340 551.507.362.1:551.510.535:551.594.12

Whitehead, J. D. (*Physics Dept., Otago Univ., Dunedin, New Zealand*), **The mesopause region of the ionosphere.** *Nature,* London, 186(4723):461, May 7, **1960.** 5 refs. **DWB**—Rocket measurements in the atmosphere between 80 and 90 km have shown that the electron density at this height is about 1,000 el/cc on a normal day. The author attempts to answer whether photo-ionization of the dust is able to give this electron density. The wave length of 2000 A corresponds to a photon energy of about 6 electron volts required to give the observed electron density in this region. The analysis of the threshold energy for photoelectric ejection and the increase of the number density of particles lead to the conclusion: 1) the layer probably is associated with the mesopause, but 2) it is undeniable that it is formed by photo-ionization of the dust particles. *Subject Headings:* **1. Rocket ionospheric data 2. Mesopause 3. Ionospheric electron densities 4. Ionization processes.**—*E.K.* Ⓢ

11.12–341 551.510.535:551.594.12:550.385.26

Appleton, Sir Edward, **Global morphology of the E and F1-layers of the ionosphere.** *Journal of Atmospheric and Terrestrial Physics,* London, 15(1/2):9–12, Sept. **1959.** 12 refs., 12 eqs. **DLC**—A report on small but significant departures from Chapman's theory of ionized layer production, evident by radio-sounding measurements of E- and F1 layers, is presented. Turnbull, Lyon and the author at Edinburgh, examining E-layer diurnal asymmetry, found that evening values of fE can be less than the corresponding morning values; noon delay is due to a motor influence of the Sq-current system on the E-layer. Certain global characteristics of fE are explained or older explanations are discussed. Parallel anomalous effects in the E- and F-layers are evaluated. The use of the symbol Δ for the distortion of any quantity, by influences not envisaged in the Chapman theory, is suggested. *Subject Headings:* **1. Ionized layer formation 2. Chapman photoionization theory.**—*O.T.* Ⓢ

B. Methods of Computation, Instruments

(Conf. also next two Sections)

11.12–342 550.3 551.510.535

Rawer, Karl (*Ionosphären-Inst. Breisach/Rh*), **Correlation in geophysics.** *Geofisica Pura e Applicata*, Milan, 43:218–226, May/Aug. **1959.** 7 figs., ref., 4 eqs. **DWB, DLC**—A study of the relative behavior of two sets of observations wherein a correlation measure was used, based on a counting procedure, has shown the advantages of the system in geophysical application as well as its limitations and the degree of physical dependence and interdependence of the parameters. These parameters are influenced by the geophysical perturbations. The method is applied to several cases of top or critical frequency of the Es layer or the normal E layer and the blanketing frequency of the Es, the minimum virtual height F2 and the maximum height of the F2 at two different locations or different years. *Subject Headings:* **1. Correlation methods 2. Ionospheric analysis.**—*N.N.* Ⓢ

11.12–343 551.501.5:551.510.535

King, G. A. M. (*Geophysical Obs., Christchurch, New Zealand*), **A convenient method of getting representative ionospheric heights.** *Journal of Geophysical Research*, Wash., D. C., 65(5):1623–1624, May **1960.** fig., 3 refs. **DLC**—Draw *h'f* curves representative of monthly conditions at each hour. Then reduce these 24 curves to true height profiles. For the particular hour, trace every *h'f* curve for the month onto a single piece of paper. Draw a smooth medium curve through them. The reduction to true heights can be done by any of the standard methods, but the ten-point methods of Shinn-Kelso (Thomas, 1959) and Schmerling (1958) are especially suitable. *Subject Heading:* **1. Ionospheric height determination.**—*E.S.* Ⓢ

11.12–344 551.510.535:551.594.12:621.396.1

Kay, Irvin, **Remarks concerning the determination of electron distribution in the ionosphere by means of radio soundings.** N. Y. Univ. Institute of Mathematical Sciences. Div. of Electromagnetic Research, Contract AF 19(604)-3495, Research Report EM-149, Nov. **1959.** 9 p. 9 refs., 17 eqs. **DWB** (510.N532r)—A discussion indicating the pitfalls which may occur in the usual analysis of the structure of the ionosphere, as well as the possibility of improving the results. For the purpose a very simple model of electromagnetic wave propagation in the ionosphere, is mathematically analyzed. It is assumed that the free electron density for this model varies with height; and also that the variation is strictly one-dimensional so that the ionized medium is plane stratified. *Subject Headings:* **1. Ionospheric electron density distribution 2. Radio sounding of ionosphere.**—*I.S.* Ⓢ

11.12–345 551.510.535:551.594.12

Wright, J. W. (*Nat'l Bur. Stand., Boulder, Colo.*), **A test of a procedure for easy estimation of representative monthly electron density profiles for the ionosphere.** *Journal of Geophysical Research*, Wash., D. C., 65(10):3215–3217, Oct. **1960.** 2 figs., 7 refs. **DLC**—A recently proposed method for obtaining a representative monthly electron-density profile for a given hour of the day applies standard $N(h)$ procedures to a single representative virtual-height curve obtained in a special way from the individual daily virtual-height curves for that hour. The method is tested by comparing examples of the resulting profile with the average of the profiles for the individual days. The differences are small compared with the dispersion of the individual profiles about their mean. It is concluded that the method is valuable for obtaining a world-wide $N(h)$ morphology with a minimum expenditure of effort. *Subject Headings:* **1. Ionospheric electron density calculations.**—*Author's abstract.* Ⓢ

11.12–346 551.510.62:551.510.535

Meynieux, Robert, **Calculs approchés relatifs à la fonction Γ et à l'équation de Weber. Application à une onde électromagnétique plane qui se propage à travers une couche ionisée.** [Approximate calculations relating to the Γ function and to Weber's equation. Application to a plane electromagnetic wave propagating through an ionized layer.] *Annales des Télécommunications*, Paris, 14(11/12):262–276, Nov./Dec. **1959.** 11 figs., 2 tables, 13 refs., eqs.

DLC—It is known that on the condition of certain simplifying hypotheses, the electric field within an ionospheric layer traversed from bottom to top by a sinusoidal plane electromagnetic wave, complies with a Weber's equation when a certain linear function of the altitude is considered as independent variable (w). This article studies the increase of errors due to Stirling's approximation for the Eulerian function Γ when the imaginary portion of the variable is larger in absolute value than 1/2. The author transforms Weber's equation into another with almost constant coefficient for the high values of the variable w, and solves it using Volterra's equations (Liouville's method). The increase of the terms of the series solution obtained for Weber's functions, assuming w^2 under a certain parallel to the real axis, supplies approximations for the odd and even solutions of Weber's equation, when the imaginary portion of the parameter n is very great and in a positive ratio inferior to 1 with regard to that of $w^2/4$, so that the one of $w^2/4-n$ be not small with respect to n. The last part of the article deals with the application of these solutions to an ionized layer, with a parabolic distribution of electron density. The reflective index is computed, and tables give the numerical results concerning the E and F layers of the ionosphere. *Subject Headings:* **1. Electromagnetic waves 2. Weber's function 3. Ionospheric radio wave propagation.**—*A. V.* Ⓢ

11.12–347 551.506.22:551.508.96 551.510.535:621.396

Peterson, A. M.; Egan, R. D. and Pratt, D. S., **The IGY three-frequency backscatter sounder.** *Institute of Radio Engineers, N. Y., Proceedings*, 47(2):300–314, Feb. **1959.** 16 figs. (incl. photos), 13 refs. **DLC**—Design criteria and operating characteristics of the IGY Fixed-Frequency Backscatter Sounder are outlined. This three-frequency (12, 18, and 30 mc) rotating-antenna pulse sounder was designed at Stanford Univ. for oblique-incidence ionosphere studies. During the IGY a network of these sounders has been operated at thirteen stations in polar, temperate, and equatorial regions. Data reduction and publication of data summaries have been carried out at Stanford using semiautomatic punch card methods. Preliminary analysis of data has yielded new information on sporadic E, magnetic field aligned irregularities, large-scale traveling disturbances in the F region, and the effects of ionospheric tilts on long-distance propagation. *Subject Headings:* **1. Ionospheric measuring equipment 2. IGY ionosphere program 3. Ionospheric data.**—*Authors' abstract.* Ⓢ

11.12–348 551.508.96:551.510.535

Bibl, K., **Aktive Hochfrequenzspektrometer für ionosphärische Echolotung. I. Direktregistrierung ionosphärischer Charakteristiken.** [Active HF spectrometer for ionospheric echo sounding, Pt. 1, Direct recording of ionospheric characteristics.] *Archiv der Elektrischen Übertragung*, Stuttgart, 14(8):341–347, Aug. **1960.** 6 figs., 14 refs. German and English summaries p. 341. **DLC**—Developing the normally used sounding equipments for ionospheric research an ionosonde has been constructed; it contains the advantages of the fast (American) ionosonde—i.e. the high speed of record sequence without mechanical limitations—and those of the slow (English-German) ionosonde—i.e. the possibility of tuned circuits in transmitter and receiver within a wide frequency range. The use of the principle of the device is not confined to ionospheric research. By using supplementary recorders it was possible to transform the ionosonde into a real "active HF spectrometer." Herein the time as a natural variable is introduced again in the records of the ionospheric characteristics. There are two fundamental possibilities: 1) recording of the virtual heights in time dependence, where the minimum heights of the ionospheric layers are clearly visible; because of the fact of missing some frequencies due to interference with the continuous presence of strong transmitters, also curves of constant plasma frequencies (i.e. constant electron densities) are written. 2) The minimum and critical frequencies in the E region and—with some restrictions—also in the F region can be written as functions of time by gates in the height ranges. Combining the records of heights as a function of time, with the frequency as a parameter, and the frequency records as function of time for different ranges in height, a direct record of the F-3000-MUF, the "maximum usable frequency" can be written. The MUF can be used physically as an excellent measure for the profile form of F2 ionization. The universal use of directly recorded ionospheric characteristics is discussed. The possibility is mentioned of comparison with the record of other geophysical parameters, which are always written in time dependence. *Subject Heading:* **1. Ionospheric sounding techniques.**—*Author's abstract.* Ⓢ

11.12–349 551.507.362.1:551.510.535:551.594.12

Holmes, Julian C. and Johnson, Charles Y. (*both, Rocket Sonde Branch, Naval Res. Lab., Wash., D. C.*), **Positive ions in ionosphere.** *Astronautics*, N. Y., 4(7):30–31, 102, 104, 105, July **1959.** figs., ports. **DLC**—For a long time mankind has been intrigued by the manifestation of physical phenomena in the Earth's ionosphere. Radio blackouts, sudden ionospheric disturbances and magnetic storms are of major importance to the scientists. Before the development of rockets, reflected radio waves were the main source of information. To understand the ionospheric phenomena, U. S. Naval Res. Lab. has developed instruments to measure the upper atmosphere's ambient neutral gas, positive ion and negative ion composition. The chief instrument of this experiment was the Bennett RF Mass Spectrometer. The mechanism of the spectrometer is described and illustrated. A spectral Bennett spectrometer was built to detect atomic and molecular hydrogen ions. *Subject Headings:* **1. Rocket ionospheric data 2. Mass spectrometers.**—*A.H.K.* Ⓢ

11.12–350 551.507.362.1:551.508.96

Sayers, J. (*Electron Physics Dept., Univ. of Birmingham*), **Self-contained measuring equipment for electron density and ionic mass spectrum.** *Royal Society of London, Proceedings, Ser. A*, 253(1275):522–525, Dec. 29, **1959.** eq. **DWB, DLC**—Two experiments (Birmingham) designed for rocket installation which may be useful in a modified form for satellite instrumentation are described: 1) the plasma dielectric method of measuring upper atmosphere electron densities and 2) an automatic mass spectrometer for the analysis of ionic masses in the upper atmosphere. *Subject Headings:* **1. Rocket instrumentation 2. Ionospheric measuring equipment.**—*E.K.* Ⓢ

11.12–351 551.510.535:621.396.6

Miya, Kenichi and Matsushita, Suekichi (*Kokusai Denshin Denwa Co., Ltd., Tokyo*), **Recording type direction finder.** *Japan. Science Council. Ionosphere Research Committee, Report of Ionosphere and Space Research in Japan*, 13(2):120–122, **1959.** 2 figs., ref. **DLC**—A note reporting the development of a recording apparatus adaptable to the present direct-vision type direction finder, currently in use for studying characteristics of ionospheric propagation waves. The note includes a diagram of the whole system of the direction finder, showing both the former finder and the recording part. The working principle of the recording part is also described and graphically represented. *Subject Headings:* **1. Ionospheric radio wave propagation 2. Radio theodolites.**—*I.S.* Ⓢ

c. Rocket Measurements

11.12–352 551.507.362.1:551.510.535:551.594.12

Berning, Warren W. (*Ballistic Res. Lab., Aberdeen Proving Ground, Md.*), **Approach to ionosphere.** *Astronautics*, N. Y., 4(7):26–27, 116–117, July **1959.** figs., port., vita. **DLC**—The IGY brought ionospheric studies to the forefront. In the years to come these studies are going to help man in his quest for space. The U. S. National Committee for IGY is conducting extensive rocket research at Fort Churchill, Canada. The rockets used there carry equipment to measure electron densities in the ionosphere, total electron content and ion densities. One of the earliest investigations by Naval Research Lab. of U. S. in its rocket program was a systematic study of the solar spectrum in the ultraviolet above the absorbing atmosphere. The activities of the Soviet Union in this field are also described. *Subject Headings:* **1. Rocket ionospheric data 2. IGY ionosphere program 3. IGY rocket program.**—*A.H.K.* Ⓢ

11.12–353 551.501.7:551.507.362.1:551.510.535:551.594.12

Berning, Warren W. (*Aberdeen Proving Ground, Md.*), **A sounding rocket measurement of electron densities to 1500 kilometers.** *Journal of Geophysical Research*, Wash., D. C., 65(9):2589–2594, Sept. **1960.** 4 figs., table, 5 refs., 10 eqs. **DLC**—At 0700 EST, Nov. 10, 1959, a sounding rocket was launched from Wallops Island, Va., for the purpose of measuring electron densities in the high ionosphere. A continuous-wave (CW) technique was employed in the measurement, and the dispersive Doppler effects at 37 and 148 Mc/s were observed.

Data are presented indicating derived electron densities to 1500 km for the up-leg of the rocket trajectory. The decrease in electron density above the F2 maximum indicates a scale height of only 30 km at 270 km but a linear scale-height gradient of 0.45 km/km from 270 to 760 km. *Subject Headings:* **1. Rocket ionospheric data 2. Ionospheric electron density distribution.**—*Author's abstract.* Ⓢ

11.12–354 551.508.96

Boggess, R. L., **Theoretical considerations in design of an ionospheric probe.** Michigan Univ. Engineering Research Institute, Contract AF 19(604)-1843, Scientific Report No. FS-2, Feb. **1959.** 39 p. 28 figs., 14 refs., 37 eqs. **DWB** (M(051) M624sc)—The general theory of a Langmuir probe is reviewed and extended with emphasis on spherical geometry. Numerical and graphical methods are provided for calculating the volt-ampere characteristic of a bipolar probe. The volt-ampere characteristics of three electrode combinations are illustrated. A brief discussion of the practical and theoretical considerations which led to the choice of a particular configuration is included. *Subject Headings:* **1. Ionospheric measuring equipment 2. Langmuir probe technique.**—*Author's abstract.* Ⓢ

11.12–355 551.510.535:551.524.7

†Boggess, R. L., **Electrostatic probe measurements of the ionosphere.** Michigan Univ. [Engineering] Research Institute, Contract AF 19(604)-1843, Scientific Report No. GS-1 (report printed under Contract AF 19(604)-6124), Nov. **1959.** 135 p. 75 figs., 2 tables, 27 refs., 53 eqs. **DWB** (M(051) M624sci)—A Langmuir probe that measured the properties of the E-layer of the ionosphere shows that the electron temperature and temperature gradient are greater than expected. Typical values such as 1980°K at 153 km, were observed. The first measurement of electron temperatures in this high altitude ranged between 112 km to 177 km. The report outlines the history of the investigation, dating back to 1901, the progress made thereafter in the theoretical and instrumental development. Discussions cover transmitted data, directly measured data, direct-channel high-sensitivity calibration, experimental probe volt-ampere characteristics, electron temperature data, reduction and the accuracy of the data reduction. Details on the electrostatic ionosphere probe experiments and of the instrumentation are given. *Subject Headings:* **1. Langmuir probe technique 2. E layer 3. Ionospheric temperatures.**—*N.N.* Ⓢ

11.12–356 551.510.535:551.594.12:551.507.362.1

Boggess, R. L.; Brace, L. H. and Spencer, N. W. (*all, Dept. of El. Eng., Univ. of Michigan*), **Langmuir probe measurements in the ionosphere.** *Journal of Geophysical Research*, Wash., D. C., 64(10):1627–1630, Oct. **1959.** 4 figs., 6 refs. **DLC**—Measurement of electron temperature and positive ion number density by a rocket-borne adaption of a Langmuir probe, above Fort Churchill, Manitoba, on Nov. 30, 1958, is described. The present probe was ejected from the rocket in order to permit complete isolation in the ionosphere. The bipolar probe, yields volt-ampere characteristic as a function of electron temperature, ion number density, ion temperature, electron number density, particle energy distribution, probe geometry, etc. A typical experimental curve, obtained by data reduction is shown on a diagram along with the determined electron temperature. Electron temperatures vs. a small altitude interval of 111 to 177 km are shown on another figure. Interesting ionospheric features, although not firmly established, are suggested. The positive-ion density vs. altitude diagram was obtained by two methods, both dependent on electron-temperature data. The applicability of Langmuir probe technique to various properties of the ionosphere is indicated. High electron temperatures in reasonable agreement with higher gas temperatures in the auroral zone over Fort Churchill indicate entirely different properties of the auroral zone atmosphere vs. those of lower latitudes. One of other three probes similarly flown permitted a sampling of a greater percentage of available electrons. *Subject Headings:* **1. Langmuir probe technique 2. Ionospheric electron density measurement techniques 3. Rocket-borne instruments.**—*O.T.* Ⓢ

11.12–357 551.507.362.1:551.510.535:551.594.12

Haycock, O. C.; Swigart, J. I. (*both, Univ. of Utah*) and Baker, D. J. (*USAF, Geophys. Res. Directorate, AFCRC, Cambridge, Mass.*), **Electron densities of the ionosphere utilizing high-**

altitude rockets. *Institute of Radio Engineers, Transactions on Antennas and Propagation,* Vol. AP-7(4):414–418, Oct. **1959.** 5 figs., 8 refs., 19 eqs. **DLC** (TK5700.I61)—The problem of determining the electron densities in the E-region of the ionosphere is approached by using 6-mc pulse transmissions from a rocket to several ground receiving stations. A logical and complete development, using dyadic techniques, is given for obtaining the propagation constant of the dissipative, anisotropic ionosphere. Special cases of the magneto-ionic formulas are given, and comparison of the ionosphere with a distributed-constant transmission line is made. In a nondissipative ionosphere, formulas are developed establishing the relationship between the effective electron density and the relative transmission delay of the 6-mc pulse. A description of the University of Utah's vertical incidence experiment is given in which a 6-mc pulse from an airborne transmitter is received simultaneously at several ground receiving stations. The relative 6-mc time-delay data from three Aerobee high-altitude rockets launched from Holloman Air Development Center on July 1, 1953, November 3, 1953, and June 13, 1956, were obtained and, from these, electron density was calculated. Curves showing the profile of electron density as a function of altitude as calculated both during the rocket ascent and descent are presented. The curves indicate a general increase of electron density throughout the E-region, rising from nearly zero at 85 km to a maximum of about 2×10^{11} electrons/m^3. The maximum altitude attained by the rockets allowed exploration up to 137 km above sea level. *Subject Headings:* **1. Rocket ionospheric data 2. Ionospheric electron density calculations 3. Electron density in E layer.**—*Authors' abstract.* Ⓢ

11.12–358 551.507.362.1:551.510.535:551.594.12

Ichimiya, Torao; Takayama, Kazuo (*both, Nippon Teleg. & Teleph. Corp., Tokyo*) and Aono, Yuichiro (*Telecomun. Kokubunji, Tokyo*), **Measurement of positive ion density in the ionosphere.** *Japan. Science Council. Ionosphere Research Committee, Report of Ionosphere and Space Research in Japan,* 13(3):155–176, **1959.** 15 figs., 2 tables, 20 refs., 3 eqs. **DWB, DLC**—To measure the positive ion densities in the ionosphere directly using a double probe method by rocket-borne instrument there are several points to be clarified. Effects of photoelectric emission from the probe, existence of negative ions in the plasma, and other disturbances are discussed. The predominant effect of photoemission on the probe current can be reduced by adoption of a small sized probe, especially a meshed spherical probe. When the motion of ions in the sheath is assumed, the plasma potential is easily determined from a recorded characteristic curve of the positive ion collections. The corrections due to the existence of the negative ions are calculated from Boyd's equation and this value is nearly equal to unity in the lower parts of the E layer and the D layer. The positive ion density in the lower parts of the ionosphere can be measured with the double probe method using the meshed spherical probe. To examine the characteristics of a meshed spherical probe, an ultra-low uniform density plasma (10^{5-6}/cm^3) is obtained in a mercury discharge tube which is constructed with a Pyrex sphere of 30 cm in diameter and with two plasma sources near the tube wall. Two movable probles are inserted in the plasma. One is a cross-ring spherical probe having two equal tungsten wire rings of 4 mm in diameter, the other is a cylindrical probe 15 mm in length, 0.38 mm in diameter. The electron density of the plasma is determined from the current at the plasma potential of the cylindrical probe. The ion density is determined from the characteristic curves of the ion collection obtained from the cross-ring spherical probe. A plot of the saturated positive ion probe current vs. voltage is in good agreement with the theory of one collision in the sheath, when a correction of voltage was made. The good agreement between the ion density and the electron density is shown in the region of 1.8×10^5 to 3×10^6 per cm^3. From these results it is concluded that the cross-ring spherical probe will be applicable to the measurement of low ion density region of the ionosphere under the influence of the intense solar radiation. To measure the positive ion density of ionosphere by double probe method, a simple cathode follower circuit amplifier is constructed. Potential difference between the probe and the other electrode, i.e. the rocket body is varied widely using a potentiometer, which is driven by a micromotor and gear system. The probe current of 10^{-6} to 10^{-9} ampere is measured as a potential drop across the input of the cathode follower circuit. The grid leak is changed in three steps, one for each rotation of the potentiometer so as to vary the range of probe current. The total weight of the amplifier including dry cells and without the probe is 1.4 kg, and continuous operation for two hours is possible. Shock test,

up to 100 g, gives no effect. Experiment with a discharge tube in the laboratory gives sufficient recording of ion density of 10^5 to 10^7 per cm^3. *Subject Headings:* **1. Rocket-borne instruments 2. Ionospheric electron density measurement techniques 3. Ionospheric probes.**—*Authors' abstract.* Ⓢ

11.12–359 551.507.362.1:551.508.96:551.510.535:551.594.12

Mechtly, E. A.; Hamaker, R. W.; Nisbet, J. S. and Quinn, T. P., **Instrumentation for rocket measurements of electron density in the ionosphere.** Pennsylvania. State University. Ionosphere Research Laboratory, Contract DA-36-061-ORD-577, Scientific Report No. 127, Jan. 1, **1960.** 96 p. 41 figs. (incl. photos), 8 refs. **DWB**—The development and testing of instrumentation for the measurement of electron density in the ionosphere by means of rockets is reported. From May through Sept. of 1959 a series of five probes of the ionosphere by means of instrumentation carried into the upper atmosphere by Jupiter rockets were conducted. Circuit diagrams, performance characteristics, and test procedures are given. Several observations made by this instrumentation and telemetered from rockets in flight are shown. A complete analysis of the observations will be the subject of a subsequent report. *Subject Headings:* **1. Rocket instrumentation 2. Rocket ionospheric measurement techniques 3. Ionospheric electron density measurement techniques.**—*Authors' abstract.* Ⓢ

11.12–360 551.507.362.1:551.510.535:551.594.12

Pfister, W. and Ulwick, J. C. (*both, Ionospheric Physics Lab., GRD, AF Camb. Res. Center*), **Analysis of pulse-delay data from rockets for the determination of electron density.** *Journal of Atmospheric and Terrestrial Physics*, London, 15(1/2):161–167, Sept. **1959.** 4 figs., 6 refs., 10 eqs. **DLC**—A re-evaluation of controversial data obtained from V2 rockets since 1946 is attempted. The method for obtaining the electron density profile per ½ km layers of the ionosphere is explained. Delay-data reductions are also shown on diagrams with fluctuations eliminated as are the effect of irregularities, and the advantages of the rocket flight results over *h'f* records. The results indicate a basis for research on the blobby structure of the ionosphere. *Subject Headings:* **1. Rocket ionospheric measurement techniques 2. Ionospheric electron density measurement techniques 3. Ionospheric structure.**—*O.T.* Ⓢ

11.12–361 551.507.362.1:551.510.535:551.594.12:546.17

Phelps, A. V. and Pack, J. L. (*both, Westinghouse Res. Lab., Pittsburgh, Pa.*), **Electron collision frequencies in nitrogen and in the lower ionosphere.** *Physical Review Letters*, N. Y., 3(7):340–342, Oct. 1, **1959.** 3 figs., 10 refs., eqs. **DLC**—Measurements of the electron collision frequencies for thermal electrons in nitrogen, combined with an improved analysis of the data obtained with rockets appear to remove the discrepancies found by J. A. Kane (1959) and M. Nicolet (1959) in their attempts to correlate the data. *Subject Headings:* **1. Electron collision frequencies 2. Rocket ionospheric data.**—*E.S.* Ⓢ

11.12–362 551.507.362.1:551.510.535:621.396.11(98)

Seddon, J. C. and Jackson, J. E., **Rocket studies of the Arctic ionosphere.** *American Geophysical Union, Transactions*, 40(1):63–65, March **1959.** **DWB**—Three rocket flights furnished strong evidence that a polar blackout is due to an abnormal number of free electrons in the D-region of the ionosphere, and that moving electric charges play an important role in this phenomenon. The polar blackout seems to involve little change in the E and F regions of the daytime ionosphere. The daytime electron density in this region of the ionosphere is similar to that in lower latitudes. The electron collision frequency with neutral particles may be ⅓ or ¼ that previously estimated. Radio-wave absorption in the Arctic ionosphere varies from extremely high to extremely low values. *Subject Headings:* **1. Rocket ionospheric data 2. Polar blackouts 3. Arctic ionosphere.**—*E.Z.S.* Ⓢ

11.12–363 551.507.362.1:551.510.535:551.594.13

Seddon, J. C. (*Nat. Aeronautics and Space Admin.*), **Rocket observations of high electron-density gradients in the ionosphere.** *American Geophysical Union, Transactions*, 41(1):113–118, March **1960.** 4 figs., 2 tables. **DWB, DLC**—A discussion of high electron density

gradients and their significance in terms of ionospheric conditions. For the purpose the U. S. Naval Research Laboratory launched a number of rockets at White Sands, New Mexico and Fort Churchill, Canada. In all ionospheric regions penetrated by the rockets, high electron-density gradients were found. In the D-region a high gradient was almost always present near the mesopause. In the E-region a slightly above high gradients were associated with sporadic-E at various levels. They appeared related to the distribution of spread-F in the F-region. *Subject Headings:* **1. Rocket ionospheric data 2. Ionospheric electron density distribution.**—*I.S.* Ⓢ

D. Satellite Measurements

See also: **VLF experiment for satellite and probe transportation** (Douglas et al.), 11.12–583.

11.12–364 551.507.362.2:551.510.535:551.594.12:061.3

Second conference on ionosphere studies using earth satellites. *American Geophysical Union, Transactions*, 40(1):67–71, March **1959. DWB**—Summary reports of types of studies now being undertaken were presented by representatives of several institutions. A table shows the field of study of each in connection with U. S. IGY satellites, Sputnik III and Sputnik I and II (analysis). All experimenters are continuing the collection and analysis of data. Results of two Soviet studies are reported briefly. Ion densities of $1\times8\times10^5/cm^3$ at 795 km and $5.2\times10^5/cm^3$ at 242 km. An increase in X-ray flux above 60°N lat. No gamma rays during solar flares. The F2 maximum may be 50–100 km lower than usually assumed. During the magnetic disturbances of May 15, 1958, ions, protons, and X-rays in the 1–100 kev range were observed. A low energy electron flux in the order of 4×10^4 ev/cm²/ster appears to be the cause. *Subject Headings:* **1. Satellite ionospheric observations 2. IGY satellite program 3. Satellite radiation measurements.**—*E.Z.S.* Ⓢ

11.12–365 551.507.362.2:551.510.535:621.396

Berning, Warren W., **Earth satellite observations of the ionosphere.** *Institute of Radio Engineers, N. Y., Proceedings*, 47(2):280–288, Feb. **1959.** 8 figs., 13 refs., 22 eqs. **DLC**—A number of so-called "First Generation" experiments for exploring the ionosphere with artificial earth satellite vehicles has either been carried out or is planned by the U. S. and the Soviet Union. Theoretical and experimental bases of these experiments are outlined and discussed, and their limitations emphasized. The first available results are from the Soviet experiments and these are discussed. Finally, a brief consideration is given to the kinds of satellite orbits desirable for ionospheric experiments. *Subject Heading:* **1. Satellite ionospheric observation.**—*Author's abstract.* Ⓢ

11.12–366 551.510.535:551.507.362.2:621.396.8

Anderson, D. S., **Ionospheric studies from an analysis of satellite radio signals with an automatic tracking filter.** Pennsylvania. State Univ. Ionosphere Research Lab., Contract AF 33 (616)-6157, Scientific Report No. 138, Sept. 1, **1960.** 58 p. 15 figs. (including photos), 4 tables, 14 refs., numerous eqs. **DWB**—A brief survey is made of the methods used for ionospheric investigation. This includes a simple illustration of the theory of the dispersive doppler experiment utilizing radio transmissions from earth satellites. Detailed descriptions of the equipment used to measure the dispersive doppler frequency are given. In particular, an automatic tracking filter which was especially designed for this study is discussed. A preliminary study was made of data obtained utilizing this equipment. The primary data consists of total electron content, from which a thickness parameter was derived. The factors which influence this parameter were investigated and the results are reported. *Subject Heading:* **1. Satellite ionospheric observation.**—*Author's abstract.* Ⓢ

11.12–367 551.507.362.2:551.510.535:551.510.62:621.396.8

Frihagen, J. and Tröim, J. (*both, Norwegian Defence Res. Estab.*), **Scintillations of the 20 Mc/s signal from the earth satellite 1958δ II.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(1):75–78, April **1960.** 3 figs. **DLC**—This note gives some preliminary results which have been obtained at Kjeller, 60°N 11°E, in connection with a study of scintillations

of the signals from the earth satellite 1958δ II. It is well known that studies of the movements and structure of the diffraction pattern formed over the ground by radio signals either reflected from or transmitted through the ionosphere, may give information about the structure and movements of the irregularities of the electron density in the ionospheric layers. However, when use is made of the signals transmitted from a satellite like 1958δ II, which itself moves with a velocity far greater than the velocity of the ionospheric irregularities, an amplitude pattern is produced over the ground which moves with a velocity determined by: (i) the velocity of the satellite and (ii) the height of the irregularities producing the scintillations as compared with the height of the satellite. It would therefore seem possible to obtain information on the height of the irregularities from observations of scintillations of satellite signals. The discussion in this note is divided between the scintillations which are produced in the F region and those which are produced in the E region. Only 20 Mc/s recordings have so far been made. *Subject Heading:* **1. Satellite ionospheric irregularities.**—*Authors' introduction.* Ⓢ

11.12–368 551.507.362.2:551.510.535:551.594.12:550.385.4

†Garriott, Owen K. (*Stanford Univ.*), **The determination of ionospheric electron content and distribution from satellite observations, Pt. 1, Theory of the analysis.** *Journal of Geophysical Research*, Wash., D. C., 65(4):1139–1150, April **1960.** 9 figs., 11 refs., 31 eqs. **Pt. 2 Results of the analysis.** *Ibid.* p. 1151–1157. 7 figs., 9 refs., 10 eqs. **DLC.** Also issued in *International Geophysical Year* 1957/1958. *IGY World Data Center A (for) Rockets and Satellites (National Academy of Sciences, Wash., D. C.), IGY Satellite Report Series*, No. 10, Jan. **1960.** 65 p. 23 figs., 21 refs., 58 eqs. **DWB** (621.1388 I612sa)—The results of observations of the radio transmissions from Sputnik III ($1958\delta_2$) in an 8 month period are presented. The measurements of integrated electron density are made in two ways, described in part 1. The measurements reveal the diurnal variation of the total ionospheric electron content; also the ratio of the total content to the content of the lower ionosphere below the height of maximum density in the F layer is obtained. An estimate of the average electron-density profile above the F-layer peak is made possible by the slow variation in the height of the satellite due to rotation of the perigee position. The gross effects of large magnetic storms on the electron content and distributions are found. *Subject Headings:* **1. Satellite ionospheric electron density measurements 2. Geomagnetic storm effects on ionosphere.**—*Author's abstract.* Ⓢ

11.12–369 551.507.362.2:551.510.535:551.594.12

Garriott, Owen K. and Little, C. Gordon (*Natl. Bur. of Stands., Boulder, Colo.*), **The use of geostationary satellites for the study of ionospheric electron content and ionospheric radio-wave propagation.** *Journal of Geophysical Research*, Wash., D. C., 65(7):2025–2027, July **1960.** 9 refs. **DLC**—This paper describes a proposed radio propagation experiment utilizing a geostationary satellite. The experimental methods for determining the total electron content of the ionosphere are discussed, and the advantages and capabilities of the methods are summarized. Other possible studies utilizing the satellite transmissions are also outlined. *Subject Headings:* **1. Satellite ionospheric electron density measurement techniques 2. Radio wave propagation experiments.**—*Authors' abstract.* Ⓢ

11.12–370 551.507.362.2:621.396.8:551.510.535:551.594.12

Graves, Carl D. (*Space Technology Labs., Inc., L. A. Calif.*), **Radio propagation measurements using the Explorer VI satellite** (*Summary only*). *Journal of Geophysical Research*, Wash., D. C., 65(9):2585–2587, Sept. **1960.** 4 refs., 6 eqs. **DLC**—This paper presents the results of an experiment to measure the electron density above the ionosphere. The experiment utilized two coherent signals, one VHF and one UHF, transmitted from the Explorer VI satellite. The evidence of our data is that the electron concentration in the vicinity of the satellite, 18,000 km above the earth, was unusually high, of the order of 10^4 electrons/cm^3. However, the results were influenced by unexpectedly high correction factors and possibly by an intense world-wide magnetic storm that occurred during the measurement period. *Subject Headings:* **1. U. S. Satellite 1959 Delta (Explorer VI) 2. Radio wave propagation studies 3. Ionospheric electron density distribution 4. Satellite ionospheric electron density measurements.**—*Author's abstract.* Ⓢ

11.12–371 551.507.362.2:551.510.535:621.396.8

Hutchinson, H. P. and Arendt, P. R., **Ionospheric scintillations of satellite signals.** *Institute of Radio Engineers, N. Y., Proceedings*, 48(4):670–671, April 1960. 7 figs., ref. **DLC**—The scintillation of satellite-emitted radio signals has been observed using two different techniques, namely, Doppler-shift frequency measurements and radio direction finding. In this shortened version of a more complete paper, there are given the results obtained using Doppler-shift measurements only. Variations from a smooth Doppler-shift curve obtained during individual orbits give a measure of the frequency scintillation occurring and thus of the roughness of the ionospheric path between the satellite and the observer. As expected, these variations are a function of frequency, and they become less as the frequency is increased. *Subject Headings:* **1. Satellite signals 2. Ionospheric radio wave propagation 3. Scintillation.** —*Authors' abstract.* Ⓢ

11.12–372 551.507.362.2:551.510.535:551.594.12

Istomin, V. G., **Nekotorye rezul'taty izmereniia spektra mass polozhitel'nykh ionov na tret'em sovetskom iskusstvennom sputnike Zemli.** [Some results of the measurement of the mass spectrum of positive ions on the third Soviet artificial earth satellite.] *Iskusstvennye Sputniki Zemli*, Moscow, No. 4:171–183, 1960. 11 figs., 5 refs., 5 eqs. **DLC**—Transl. into English by U. S. Joint Publications Research Service as *U. S. National Aeronautics and Space Administration, Technical Translation* F-7, April 1960. 19 p.—The radio frequency mass-spectrometer installed in the third satellite registered positive ions with mass values of 32, 30, 28, 18, 16, and 14 which were identified as single charged ions of molecular oxygen, nitrogen oxide, molecular nitrogen, atomic oxygen, and atomic nitrogen, respectively. The data obtained ranged from altitudes of 225 to 980 km and latitudinal intervals of 27° to 65° north latitude. Certain patterns in the changing composition of the ionosphere with altitude and geographic latitude have been discovered. *Subject Headings:* **1. Satellite ionospheric observations 2. Mass spectrometer analysis 3. Ionospheric ionization 4. Positive ions in ionosphere.**—*Author's abstract.* Ⓢ

11.12–373 551.508.953:551.510.53:551.594.12

Istomin, V. G., **Radiochastotnyĭ mass-spektrometr dlia issledovaniĭ ionnogo sostava verkhneĭ atmosfery.** [Radio-frequency mass spectrometer for investigating the ion content of the upper atmosphere.] *Iskusstvennye Sputniki Zemli*, Moscow, No. 3:98–112, 1959. 15 figs., 19 refs. **DLC, DWB.** Summary in *U. S. National Aeronautics and Space Administration, Technical Translations*, F-8:9, April 1960. Complete transl. to be issued in the *Technical Translations* series.—Detailed description of the radio-frequency mass spectrometer used to determine the ionic composition of upper atmosphere. Data on the mass spectrum of positive ions in the ionosphere at an altitude up to 855 km were obtained from Sputnik III and from high-altitude rockets. The mass-determination range of the device is from 6–48 atomic mass units and the scanning time for the whole range is 1.7 sec. *Subject Headings:* **1. Mass spectrometers 2. Ion composition of upper atmosphere 3. Soviet satellite 1958 Delta (Sputnik III).**—*E.K.* Ⓢ

11.12–374 551.510.535:551.507.362.2

Munro, G. H. (*Radio Research Lab., Electrical Eng. Dept., Univ. of Sydney*), **Ionospheric information from satellite signals.** *Nature*, London, 187(4742):1017–1018, Sept. 17, 1960. 2 figs., 3 refs. **DLC**—Observations of fading rates of signals from satellites have been analyzed for various observing sites and fading rate profiles have been built up. These are converted to ionization profiles by comparison with corresponding ionosonde recordings. Results derived from various satellites for a two year period are illustrated diagrammatically. The difference between the summer and winter distributions is marked. The main purpose of this paper is to report the remarkable result in Sept. 1958 when the rate increased practically from summer to winter values within two days when the satellite was at a height of 400 km. These results are also illustrated diagrammatically. *Subject Headings:* **1. Satellite ionospheric observations 2. Seasonal ionospheric variations.**—*R.B.* Ⓢ

11.12–375 551.507.362.2:551.510.535:551.594.12

Ross, W. J. (*Pennsylvania State Univ.*), **The determination of ionospheric electron content from satellite Doppler measurements, Pt. 1, Method of analysis.** *Journal of Geophysical Research*, Wash., D. C., 65(9):2601–2606, Sept. **1960.** 5 refs., 10 eqs. **Pt. 2, Experimental results,** *Ibid.*, p. 2607–2615. 9 figs., 6 refs. **DLC**—A procedure for determining the ionospheric electron content up to the height of an active satellite from Doppler data is developed. The equations derived from first-order theory are discussed and corrected separately for earth curvature, large refraction, off-zenith orbit, vertical satellite motion, horizontal ionospheric variations, and the effects of the earth's magnetic field. The methods were developed initially for use with the harmonic radiations from satellite 1958δ_2 at frequencies of approximately 20 and 40 Mc/s, but may be adapted to other harmonic frequency ranges. In Part 2 the preliminary results of the analysis of daytime Doppler frequency records from satellite 1958δ_2 for the period Sept. 1958 to Dec. 1959 are presented in the form of ionospheric electron content derived using the methods of part 1. Strong seasonal effects are found, the content being lower and the equivalent slab thickness greater in summer than in winter. Magnetic control of the summer ionosphere content is indicated, although the equivalent slab thickness is almost constant. The values of content obtained agree fairly well with the results of independent polarization rotation studies. *Subject Headings:* **1. Satellite ionospheric electron density measurements 2. Ionospheric electron density variation.**—*Author's abstract.* Ⓢ

11.12–376 551.507.362.2:621.396.9:551.510.535:551.594.12

Schmelovsky, Karl Heinz; Klinker, Ludwig and Knuth, Robert (*all, Obs. for Ionosphere Research, Kuhlungsborn*), **Über die Elektronenkonzentration in der äusseren Ionosphäre nach Untersuchungen des Faraday-Fadings am Satelliten 1958δ_2.** [Electron concentration in the upper atmosphere from investigations of the Faraday-fading of 1958δ_2 satellite.] *Beiträge zur Geophysik*, Leipzig, 68(6):321–341, **1959.** 10 figs., table, 10 refs., 13 eqs. German and English summaries p. 321. **DWB, DLC**—Methods for evaluating the Faraday fading of satellite signals are derived from the Appleton-Hartree formula. Reliable values for the total electron number can only be obtained by an iterative approximation based on a sufficient number of observations. A height-electron density distribution for the region between the F2 layer and 1200 km is determined from 135 observations during the summer 1958. Between 500 to 900 km there is a decrease in electron density with exp $(-aH)$; $a=2.5\times10^{-3}$ km^{-1}. The total electron content up to 1200 km is 3.6×10^{17} m^{-2}; about 70% of this amount belong to the region above F2 layer maximum. About $\frac{2}{3}$ of the diurnal variation in total electron number is produced below the F2 layer maximum. During magnetic and ionospheric disturbances there is a decrease of total electron number. *Subject Heading:* **1. Satellite ionospheric electron density measurements.**—*Author's abstract.* Ⓢ

11.12–377 551.507.362.2:621.396.8:551.510.535

Thomas, J. A. (*Univ. of Queensland, Brisbane*) and Hibberd, F. H. (*Univ. of New England, Australia*), **Satellite Doppler measurements and the ionosphere.** *Journal of Atmospheric and Terrestrial Physics*, London, 13(3/4):376–379, Feb. **1959.** fig., 2 refs., 3 eqs. **DLC**—An outline of the method of an analysis of the effect of the ionosphere on the simultaneous Doppler frequency shifts of the 20 and 40 Mc/s signals from Sputnik I is presented. *Subject Headings:* **1. Satellite ionospheric observations 2. Doppler frequency shift 3. Ionospheric radio wave propagation.**—*O.T.* Ⓢ

11.12–378 551.507.362.2:621.396.9:551.510.535:551.594.12

Wilson, D. Mc L. A. (*Cavendish Lab., Cambridge*), **Electron density measurements in the upper ionosphere using the Faraday rotation of radio signals from artificial satellites.** *Nature*, London, 186(4725):623–624, May 21, **1960.** fig., 2 refs. **DWB**—Several observers using the Faraday rotation of radio signals assumed that the ionosphere is spherically stratified. The signals of satellites 1957α_2 and 1958δ_2, observed at Cambridge, have shown that the variation of the ionosphere with latitude and longitude must be taken into account near or below the peak of the F2 layer if results consistent with vertical incidence soundings are to be obtained. The effect of the horizontal variation of the ionosphere is shown. On this occasion the satellite

was slightly above the F2 layer peak. Satellite passes above the F2 peak indicate that the electron density falls off with a scale height of approximately 230 km and the average ratio of the total electron content above the peak to that below is 3.4 to 1. *Subject Headings:* **1. Satellite ionospheric electron density measurements 2. Faraday effect.**—*E.K.* Ⓢ

11.12–379 551.507.362.2:621.396.6:551.510.535

Zachary, W. W.; Wolff, E. A. and Katzin, M., **Determination of ionosphere parameters by means of a satellite antenna-type probe.** Electromagnetic Research Corporation, Wash., D. C., Contract AF 19(604)-6656, Scientific Report No. 1, June 30, 1960. 52 p. 9 figs., 11 refs., 65 eqs.—A spherical antenna-type probe for determining the parameters of the ionosphere is described. This consists of a main slot around which are disposed pairs of small orthogonal slots. By applying a driving voltage to the main slot and measuring the input impedance as well as the voltages induced in the orthogonal slots, the ionization density, collision frequency, and vector earth's magnetic field may be determined. These are local values since the reaction of the medium on the probe is effectively limited to distances of the order of less than a wavelength. As a preliminary to the main analysis, the input admittance of a slotted plane antenna in a magneto-ionic medium is analyzed. The solution is obtained in a form suitable for numerical evaluation. Measurement systems for the determination of the quantities necessary to evaluate the parameters of the ionized medium are considered. Three systems are shown and their relative advantages and disadvantages are outlined. A suitable measurement system appears to be quite feasible of realization. *Subject Headings:* **1. Satellite ionospheric observation 2. Radio equipment 3. Ionospheric probes.**—*Physics Abstracts.* Ⓢ

E. E Layer

See also: **Indices of solar activity during IGY** (Bazzard), 11.12–45; **Cause of magnetic storms and bays** (Duncan), 11.12–307; **E region winds** (Ward), 11.12–418; **Drift in E region** (Rawer), 11.12–419.

11.12–380 551.590.2:551.510.535:551.594.12

Beynon, W. J. G. and Brown, G. M. (*both, Univ. College of Swansea*), **Region-E and solar activity.** *Journal of Atmospheric and Terrestrial Physics*, London, 15(1/2):168–174, Sept. 1959. 6 figs., 2 refs., 4 eqs.—The influence of unequal variations of solar activity on the E layer is examined. Theoretical considerations indicate the influence of seasonal changes, the effect of ellipticity of the earth's orbit, perturbing influences of geomagnetic distortion, magnetic disturbance and lunar tidal effects. The relationship between fE and sunspot number is shown at one station for two seasons. The examination of solar cycle variations shows various effects of years of rising and falling solar activity on fE. Short period (27 day) variations reflect a clear relation of ionization density with a similar variation of sunspot number. The E layer showed less sensitivity to short-period sunspot changes than to long-period ones supposedly due to the fact that over short periods the background radiation remains substantially unchanged and the E layer changes in electron density derive from temporary increase of radiation associated with courses of activity. *Subject Headings:* **1. E region 2. Solar-ionospheric relationships 3. Ionospheric electron densities.**—*O.T.* Ⓢ

11.12–381 551.510.535:551.594.12

King, G. A. M. (*Geophysical Obs., Christchurch, New Zealand*), **The ionospheric E layer at Cape Hallett.** *Journal of Atmospheric and Terrestrial Physics*, London, 16(1/2):186–187, Oct. 1959. table. **DWB, DLC**—Ionograms from April 20–Aug. 14, 1958 for studying the variations with solar zenith angle of f_oE using 1–2 Mc/s frequency facilitating separation of UV ionization and that from particle influx are compared against values expected from a model ionosphere. The calculated values of f_oE are in good agreement with the observed ones. *Subject Headings:* **1. E layer variations 2. Ionospheric ionization.**—*W.N.* Ⓢ

11.12–382 551.510.535:551.590.2

Minnis, C. M. and Bazzard, G. H. (*both, DSIR Radio Res. Station, Slough*), **A world-wide semi-annual cycle in the E-layer of the ionosphere.** *Journal of Atmospheric and Terrestrial*

Physics, London, 18(4):306–308, Aug. 1960. fig., 4 refs. **DLC**—A study of the E-layer character figure for eight stations in the north and south hemispheres has disclosed an unexpected semi-annual cycle the variations in which have the same sign in both hemispheres. The amplitude of the cycle is about ±15% near the maximum of the solar cycle but vanishes at the minimum. Its origin has not yet been discovered but several possibilities are discussed. *Subject Headings:* **1. E layer variations 2. Solar-ionospheric relationships.**—*Authors' abstract.* Ⓢ

11.12–383 551.510.535:551.594.13

Robinson, B. J. (*Radiosterrewacht, Dwingeloo, Netherlands*), **Diurnal variation of the electron distribution in the ionospheric E-layer.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(2/3):215–233, June 1960. 8 figs., 2 tables, 47 refs., 10 eqs. **DLC**—By means of a special sounder $h'(f)$ curves have been obtained with an accuracy sufficient to determine the distribution of the ionization in the E layer. The variation of the scale height in the E region has been deduced from the shape of the layer. The diurnal variation of the ionization has yielded an estimate of the recombination coefficient. It is shown that there may be vertical drift effects comparable with the effects of recombination. The results determined from the layer shapes are compared with the information provided by accurate penetration-frequency measurements. *Subject Headings:* **1. E layer recombination 2. Diurnal ionospheric variations 3. Ionospheric electron density distribution 4. Ionization balance.**—*Author's abstract.* Ⓢ

11.12–384 551.510.535:551.594.13(98)

Wright, J. W. (*Natl. Bur. of Standards, Boulder, Colo.*), **Some magnetoionic phenomena of the Arctic E-region.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(4):276–289, Aug. 1960. 15 figs., table, 9 refs., eq. **DLC**—Several unusual phenomena of E-region ionogram echoes obtained at Thule, Greenland (mag. dip 85–5°) are described. They are explained as the effects of electron collisions on the propagation of radio waves at high-magnetic latitudes. The third magnetoionic component (*Z*-echo) is explained in this way and several of its distinguishing features are explained and illustrated. New phenomena demonstrate the existence of an *E*-pause (valley above $h_{max}E$), and permit the measurement of electron densities and collision frequencies therein. *Subject Headings:* **1. E region 2. Magnetoionic theories 3. Electron collision frequencies in E layer 4. Thule, Greenland.**—*Author's abstract.* Ⓢ

Sporadic E (Es)

11.12–385 551.510.535:551.594.12

Gerson, Nathaniel C. (*South Lincoln, Mass.*), **Annual distribution of sporadic-E.** *Journal of Atmospheric and Terrestrial Physics*, London, 16(1/2):189–191, Oct. 1959. 2 figs. **DWB, DLC**—This study is based on some 19,000 V.H.F. contact reports during 1949 over North America. The Es cloud location from each contact was determined and summarized into number of hours of occurrence of reflections within a degree square and mapped in isopleths. A diagram featuring monthly distribution of sporadic-E shows it is almost entirely a summer phenomenon in the northern hemisphere. *Subject Heading:* **1. Sporadic E layer (Es).**—*W.N.* Ⓢ

11.12–386 551.510.535:551.594.12

Hagg, E. L.; Muldrew, D. and Warren, E. (*all, Defence Res. Board, Shirley Bay, Ottawa*), **Spiral occurrence of sporadic-E.** *Journal of Atmospheric and Terrestrial Physics*, London, 14(3/4):345–347, June 1959. 2 figs., table, 5 refs. **DWB, DLC**—An analysis of an isolated high density sporadic-E ionization at high latitudes is presented. The theoretical spirals obtained, as shown on the diagrams support Störmer's theory which predicted a ring current flowing around the earth parallel to the geomagnetic equatorial plane. *Subject Headings:* **1. Sporadic E layer (Es) ionization 2. Störmer ring.**—*O.T.* Ⓢ

11.12–387 551.510.535:551.594.12

Heisler, L. H. and Whitehead, J. D. (*both, Univ. of Sydney, Australia*), **F-region traveling disturbances and sporadic-E ionization.** *Journal of Geophysical Research*, Wash., D. C.,

65(9):2767–2773, Sept. 1960. 7 figs., table, 7 refs. **DLC**—Ionosonde records taken at Sydney (33°52′S, 151°11′E) during July 1955 have been analyzed statistically for the occurrence of F-region traveling ionospheric disturbances and Es. It is shown beyond reasonable doubt that the phenomena are associated, and that, as previously suggested by one of the authors, the advent of a traveling ionospheric disturbance is sometimes accompanied by an increase in Es critical frequency. An apparent small secondary effect in Es occurring some minutes after the F anomaly is also discussed. *Subject Headings:* **1. F region 2. Sporadic E layer (Es) ionization 3. Ionospheric disturbances.**—*Authors' abstract.* Ⓢ

11.12–388 551.510.535:551.594.12

†Julák, Otakar, **Statistický výzkum Es vrstvy v nočním čase ve středních šířkách.** [Statistical investigation of the *Es* layer at night in moderate latitudes.] *Geofysikální Sborník*, Prague, 1958, issued **1959.** p. 473–500. 14 figs., 4 tables, 36 refs. Russian and English summaries p. 499–500. **DWB**—A statistical study of daily and seasonal variations in *Es* layer ionization. The diurnal minimum is around midnight, the seasonal minimum is in the spring, the seasonal maximum is in August, high values are maintained in autumn and winter. Both diurnal and seasonal distribution is dependent on the frequency of sporadic meteors and the occurrence of periodic swarms. The summer months of 1954 with particularly low R numbers had very high fEs. *Subject Headings:* **1. Sporadic E layer (Es) ionization 2. Statistical studies of Es layer variations.**—*E.Z.S.* Ⓢ

11.12–389 551.590.22:551.510.535:551.594.13

Knecht, R. W. (*Natl. Bur. Stand., Boulder, Colo.*), **An additional lunar influence on equatorial *Es* at Huancayo.** *Journal of Atmospheric and Terrestrial Physics*, London, 14(3/4):348–349, June **1959.** 2 figs., 7 refs. **DWB, DLC**—Observations at Huancayo, Peru, are presented to show additional influence of the moon on the sudden day-time disappearance of equatorial Es. An example of its is characterized and illustrated by an ionogram. The analysis of the observations of May 1957 to April 1958, illustrated also by a diagram, support MATSUSHITA's theory that equatorial Es was caused by vertical upward drift forces due to eastward flowing electric currents and his supposition that westward flowing currents caused by lunar tidal forces might weaken the equatorial Es. *Subject Headings:* **1. Lunar diurnal ionospheric tides 2. Sporadic E layer (Es) 3. Ionospheric drift.**—*O.T.* Ⓢ

11.12–390 551.510.535:621.396.8

Rawer, Karl, **Etude des propriétés de transparence de la couche ionosphérique Es dite sporadique.** [Study of the transparency properties of the ionospheric Es layer, called sporadic layer.] *Académie des Sciences, Paris, Comptes Rendus*, 250(8):1517–1519, Feb. 22, **1960.** 2 tables, 3 refs. **DWB, DLC**—The simultaneous observation on ionograms of echoes from the Es and F layers in a rather wide frequency scale proves that the Es ionospheric layer is heterogeneous and possesses a cloudy structure in the horizontal plane. If f_b designates the frequency corresponding to the minimum ionization originating in the upper layers and f_t the frequency corresponding to the maximum ionization originating in the inferior layers, the layer will be occluded if $f_t - f_b = 0$, semi-transparent if $0 < f_b/f_t < 1$ and transparent if $f_b/f_t = 0$. The degree of occlusion of the layer Es could be determined using the data of the IGY published by the ionospheric stations. With respect to latitude there are three distinct zones: the large zone of middle latitudes, the zone surrounding the magnetic equator and the auroral zone. In the first zone, by far the largest, the degree of occlusion has a high median during daytime and a weaker one during nighttime; hence the Es layer is more often occluded than was usually considered previously. The equatorial zone seems to be rather thin in latitude and centered on the magnetic equator. The equatorial Es type occurs in this zone during daytime, distinguishing itself distinctly by its greater transparency. Nevertheless, even on the magnetic equator, the median occlusion is still slightly greater during the day than during the night. On the other hand, in the auroral zone (Point Barrow) the presence of the Es layer during the day is rare. During the night, the median degree of occlusion is somewhat greater than that of temperate latitudes. *Subject Headings:* **1. Sporadic E layer (Es) 2. Radio wave occlusion.** —*A.V.* Ⓢ

F. F Layer

See also: **Draft in F region** (Becken, Maehlum), 11.12–420; **Tides in F layer** (Gassmann), 11.12–424; **Movements of F layer during bay disturbances** (Kohl), 11.12–424.

11.12–391 551.510.535:551.594.13

Bandyopadhyay, P. (*Univ. Calcutta, India*), **Electron distribution in the F-layer of the ionosphere over Haringhata (Calcutta) on quiet and disturbed days.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(2/3):127–134, June **1960.** 7 figs., 8 refs., 3 eqs. **DLC**—The paper presents the results of a study of the behavior of the F layer of the ionosphere over Haringhata (Calcutta) on quiet and disturbed days. The study is made from "mean quiet F layers" and "mean disturbed F layers" constructed for this place following the method of the Cambridge group of workers. The quiet-day results are further examined with a view to verifying the model of the coefficient of electron loss in the layer, as derived by the above workers. *Subject Headings:* **1. Electron density in F layers 2. Ionospheric electron density distribution 3. Calcutta, India.**—*Author's abstract.* Ⓢ

11.12–392 551.590.24:551.510.535:551.594.13

Datta, S.; Bandyopadhyay, P. and Datta, R. N., (*all, Univ. of Calcutta, India*), **Ionospheric observations on the F-region during the solar eclipse of April 19, 1958.** *Journal of Atmospheric and Terrestrial Physics*, N. Y., 16(1/2):182–185, Oct. **1959.** 4 figs., 3 refs. **DWB, DLC**—Effects of the eclipse derived from observations at the Ionosphere Field Station at Haringhata of the Institute of Radiophysics and Electronics, University of Calcutta, are presented. Investigations of variations of maximum electron density and of the F2-layer peak are illustrated by three diagrams. Only some indications of the appearance of an F1 peak could be obtained. An additional peak in F1½, as shown on its ionogram, is probably not an eclipse effect. *Subject Headings:* **1. Eclipse effects on F2 layer 2. Ionospheric electron density variation.**—*O.T.* Ⓢ

11.12–393 551.510.535:550.385.4

Somayajulu, Y. V. (*Pennsylvania State Univ.*), **Magnetic storm effects on the F region of the ionosphere.** *Journal of Geophysical Research*, Wash., D. C., 65(3):893–895, March **1960** fig., table, 5 refs. **DLC**—Some preliminary results of the true-height analysis carried out for the F region of the ionosphere for Washington, D. C., during individual severe SC-type magnetic storms are presented. *Subject Headings:* **1. F layer height 2. Geomagnetic storm effects on ionosphere.**—*Author's abstract.* Ⓢ

11.12–394 551.510.535:551.594.12(213)

†Duncan, R. A. (*C. S. I. R. O., Australia*), **The equatorial F-region of the ionosphere** *Journal of Atmospheric and Terrestrial Physics*, London, 18(2/3):89–100, June **1960.** 12 figs. 23 refs., 21 eqs. **DLC**—A comparison of the data from ionospheric sounders at Chimbote and Panama, shows that afternoon critical frequencies in the equatorial zone are negatively correlated with those on the same meridian in the sub-tropical belts. This supports Martyn's suggestion that ionization is transported from the equatorial zone to the sub-tropics. The process suggested by Martyn, electrodynamic lift at the equator followed by diffusion under gravity along the geomagnetic field lines to the sub-tropical belts is investigated quantitatively and it is shown that the process can account for the high subtropical electron densities observed. It is shown that the diurnal variation of the correlation between Chimbote and Panama critical frequencies, the diurnal variation in the height, thickness and electron density of the equatorial F-region, and the diurnal variation of electron density enhancement in the sub tropics, can all be ascribed to the simple diurnal electrodynamic tide expected from the observed magnetic variations, in conjunction with diffusion along the geomagnetic field lines. *Subject Headings:* **1. Equatorial ionosphere 2. F layer critical frequencies 3. Ionospheric tides.**—*Author's abstract.* Ⓢ

11.12–395 551.510.535:551.594.13:621.396.

Khastgir, S. R. and Singh, R. N., **The size of the moving irregularities in the F-region and the spread angle of the radio waves scattered from them.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(2/3):123–126, June **1960.** 5 figs., 3 refs., 4 eqs. **DLC**—The

three-spaced receiving fading records of the F echo at 3.8 Mc/s taken at Banaras during the period from Nov. 1956 to Sept. 1958 show certain characteristic patterns. The fading patterns which were considered as due entirely to the movement of large ionospheric irregularities are analyzed by the method of BRIGGS and PHILLIPS (1950). As a result of this analysis the average characteristic length of the irregularities is found to be 270 m and the average angular spread is found to be 6°. The variations of these parameters are shown with the help of histograms. The records show some diurnal and seasonal variations, but no definite conclusion can be made regarding such variations. *Subject Headings:* **1. Ionospheric irregularities 2. Ionospheric movements 3. Banaras, India.**—*Authors' abstract.* Ⓢ

11.12–396 551.510.535:551.594.13

Gopal Rao, M. S. V.; Rao, B. Ramachandra and Ramachandra Rao Pant, P., **Correlation of spread-F activity with F-region height changes.** *Journal of Atmospheric and Terrestrial Physics*, London, 17(4):345–347, Feb. **1960.** fig., table, 3 refs. **DLC**—An index number in the range 0 to 10 is alloted to each observation depending on the spread-F extent. This enables us to follow the hourly, daily, and monthly variations. The hourly spread-F index obtained as an average of the indices at all the spot frequencies, reaches a maximum value between 2000 and 2100 hours LT. This value is found to be in close correlation with the average rise in the heights of F region at the low frequency of the h'-F record between 1800 and 1900 hours. A correlation coefficient of 0.57 is obtained for all the pairs of values considered. The results are important in the prediction of spread-F occurrence and extent and are to be given due consideration in any theory attempting to explain the origin of spread-F irregularities. *Subject Headings:* **1. F layer height 2. Spread F variations.**—*E.Z.S.* Ⓢ

11.12–397 551.510.535(213)

Lyon, A. J.; Skinner, N. J. (*both, University College, Ibadan, Nigeria*) and Wright, R. W. (*University College of Ghana, Legan, Ghana*), **Equatorial spread-F and F-layer heights.** *Nature*, London, 187(4743):1086–1088, Sept. 24, **1960.** 6 figs., 5 refs. **DLC**—The mean percentage frequency of the occurrence of spread F at night and the mean maximum virtual height (h' max. F) reached by the F layer in the early part of the night for both magnetically quiet and magnetically disturbed conditions have been computed for a number of stations. Figures are given showing the variation with magnetic latitude of these factors for three seasons. It is concluded 1) that the equatorial belt, within which spread F is a common occurrence under magnetically quiet conditions extends roughly from 20°N to 20°S, 2) that within this belt there is in general a sharp diminution of spread F during magnetic disturbance, and 3) there is a remarkably close coincidence between the spread F belt and the belt of steep sunset rise in h'F. *Subject Headings:* **1. Equatorial ionosphere 2. Spread F variations.**—*R.B.* Ⓢ

F2 layer

See also: **Horizontal movements in F2** (Thomas), **11.12–421.**

11.12–398 551.510.535:551.594.12

Croom, Sheila; Robbins, Audrey, and Thomas, J. O. (*all, Cavendish Lab., Cambridge*), **Two anomalies in the behaviour of the F2 layer of the ionosphere.** *Nature*, London, 184(4704) Supp. No. 26:2003–2004, Dec. 26, **1959.** 3 figs., table, 6 refs. **DWB**—The anomalous behavior of the F2 layer is described in respect of: 1) geomagnetic anomaly, 2) an unexpected diurnal asymmetry. These phenomena are further explained by consideration of the electron distributions. Figures show the values of electron density calculated for a series of different heights. The diurnal changes in F2 region can be quite different in different places. The pre-noon electron densities are greater than the corresponding afternoon ones. Further data at other seasons and other epochs of sunspot cycle are required to establish precisely the extent of the diurnal asymmetry. *Subject Headings:* **1. F2 layer changes 2. Electron density in F2 region 3. F2 anomalies.**—*A.H.K.* Ⓢ

11.12–399 523.746:551.510.535:621.396.1

Cummack, C. H. (*Geophysical Obs., Dept. of Scient. & Indust. Res., New Zealand*), **A comparison of the critical frequency of the F2-layer between Rarotonga and Maui.** *Journal*

of Atmospheric and Terrestrial Physics, London, 13(3/4):372–374, Feb. **1959.** 2 figs., ref. **DLC**—The observations carried out by the Geophysical Observatory, Dept. Scientific and Industrial Research, New Zealand at Rarotonga and Maui of similar geographic and geomagnetic co-ordinates for the years 1950 to 1954 showed for the annual component a possibility of relation between amplitude and sunspot-cycle, and a seasonal relation between the amplitude variations and solar declination. The annual component may be part of a general north-south anomaly. The seasonal component depends on solar declination. *Subject Headings:* **1. F2 layer critical frequencies 2. Solar-ionospheric relationships.**—*O.T.* Ⓢ

11.12–400 551.510.536:550.388.2:551.594.6

Johnson, Francis S. (*Lockheed Missiles and Space Div., Calif.*), **The exosphere and upper F region.** *Journal of Geophysical Research*, Wash., D. C., 65(9):2571–2575, Sept. **1960.** 4 figs., 19 refs. **DLC**—The view is presented that the outer portion of the earth's ionosphere, through which radio whistlers propagate, has its origin in the earth's atmosphere rather than in interplanetary space. The outer portion of the earth's neutral-particle exosphere is dominated by neutral atomic hydrogen which is escaping steadily from the earth's atmosphere. Some of this neutral atomic hydrogen reacts with atomic oxygen ions near the base of the exosphere, giving rise to hydrogen ions. Diffusive equilibrium is the dominant factor controlling the relative concentration of ions and neutral particles near the base of the exosphere. At higher levels, the geomagnetic field exerts an influence in that it causes the ions and electrons to rotate with the earth, and the centrifugal force modifies the force of gravitational attraction appreciably. The ion electron plasma through which the radio whistlers propagate is hydrostatically supported within the magnetic tubes of force. *Subject Headings:* **1. Exosphere 2. F region 3. Whistlers.**—*Author's abstract.* Ⓢ

11.12–401 551.510.535:551.594.12

Likhachev, A. I. (*Siberian Physics and Engineering Inst., V. V. Kuibyshev, Tomsk State U.*), **Diurnal sunlit component of F2 layer ionization during the first half of the day.** *Soviet Astronomy AJ*, New York, 4(1):129–133, July/Aug. **1960.** 4 figs., 4 tables, refs., eq. **DLC.** Transl. of **Sutochnaia osveshchennaia sotavliaiushchaia ionizatsii sloia F2 za pervuiu polovinu dnia.** *Astronomicheskiĭ Zhurnal*, Moscow, 37(1):135–139, Jan./Feb. **1960. DLC**—Results are given of research on the diurnal variation of ionization in the F2 ionospheric layer during the first half of the day. It is shown that the variation in the diurnal sunlit component over a year's time correlates excellently with the sine of the Sun's zenith angle. The annual amplitudes of the diurnal sunlit component are correctly determined by the mean annual values of sunspot numbers. During the summer months, ionization in the F2 layer reaches saturation at the latitude of Tomsk. Introduction of the parameter foF2∼for the F2 ionization layer, makes for a rather accurate prognosis of the state of ionization over a protracted period. *Subject Headings:* **1. F2 layer ionization 2. Diurnal ionospheric variations 3. Tomsk, Siberia.**—*Author's abstract.* Ⓢ

11.12–402 523.74:551.510.535:551.594.13

Minnis, C. M. and Bazzard, G. H. (*both, DSIR, Radio Res. Station, Slough*), **The geographical distribution of ionization in the F2-layer.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(2/3):181–183, June **1960.** 2 figs., 2 refs., eq. **DLC**—For any location the monthly mean F2-layer critical frequency, foF2, can be expressed as a family of linear functions of an ionospheric index of solar activity. The intercepts of these functions have been determined for sixty-five locations at noon and form a reliable tool for investigating the geographical distribution of foF2 at minimum solar activity. It has been found that the equatorial trough in foF2 cannot be conclusively proved to exist in the western hemisphere at certain times of the year. *Subject Headings:* **1. F2 layer ionization 2. foF2 distribution 3. Solar activity-F2 layer relationships.**—*Authors' abstract.* Ⓢ

11.12–403 523.74:551.510.535:551.594.12

Minnis, C. M. and Bazzard, G. H. (*both, DSIR Radio Res. Station, Slough*), **A monthly ionospheric index of solar activity based on F2-layer ionization at eleven stations.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(4):297–305, Aug. **1960.** fig., 5 tables,

6 refs., 3 eqs. **DLC**—A monthly index has been constructed for the period 1938 to date, using monthly mean or median noon values at foF2 at eleven widely-distributed stations. The correlation between foF2 at noon and this index is significantly greater than that between foF2 and either the 3 month weighted mean sunspot number or the monthly mean solar radio noise flux at 2800 Mc/s. Numerical estimates have been made of the errors incurred in forecasting noon and midnight foF2 several months ahead using these three indices as guides to the trend of solar activity. *Subject Headings:* **1. F2 layer ionization 2. Solar activity—F2 layer relationships.**—*Authors' abstract.* Ⓢ

11.12–404 551.510.535:551.594.12:550.388

Rastogi, R. G. (*Nat. Res. Council, Ottawa*), **Abnormal features of the F2 region of the ionosphere at some southern high-latitude stations.** *Journal of Geophysical Research*, Wash., D. C., 65(2):585–592, Feb. **1960.** 10 figs., 6 refs. **DLC**—The paper describes some abnormal features of the F2 layer at high-latitude stations in the southern hemisphere. The variation of the midday value of the critical frequency of the F2 layer (foF2) with magnetic dip shows asymmetry between the northern and southern stations of the west (American) zone, but not of the east zone. The control by the earth's magnetic field is indicated in the latitudinal distribution of even the midnight values of foF2. The diurnal variation of foF2 at Port Lockroy shows abnormal minimum at midday and maximum at midnight during the summer months. These abnormal features of the F2 layer at Port Lockroy are explained on the basis of the horizontal transport of ionization as guided by the earth's magnetic field. *Subject Headings:* **1. F2 anomalies 2. Geomagnetic-ionospheric relationships.**—*Author's abstract.* Ⓢ

11.12–405 551.557:551.510.535:551.594.13

†Rastogi, R. G., **Asymmetry between the F2 region of the ionosphere in the northern and southern hemispheres.** *Journal of Geophysical Research*, Wash., D. C., 65(3):857–868, March **1960.** 8 figs., 32 refs. **DLC**—The paper describes the asymmetry in the seasonal variations of the critical frequency of the F2 layer at high-latitude stations in the northern and southern hemispheres during the years of minimum sunspot number. The variations of the F2 layer at pairs of stations similarly situated on opposite sides of the equator are studied for different hours of the day and for different stages of solar activity. During years of low sunspot number, the curves of seasonal variations of foE, foF1 as well as foF2 are very similar to each other, and the well known summer decrease of noon foF2 is not present at southern stations. The various hypotheses advanced to explain the abnormalities in the F2 region are examined to explain the asymmetry, and a plausible cause is suggested on the basis of wind systems in the F2 region, mainly the horizontal transport of the ionization. *Subject Headings:* **1. F2 layer north-south asymmetry 2. Ionospheric winds.**—*Author's abstract.* Ⓢ

11.12–406 551.510.535:551.557.3

†Rastogi, R. G., **A synoptic study of the F2-region of the ionosphere in the Asian zone.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(4):315–331, Aug. **1960.** 19 figs., table, 22 refs. **DLC**—A detailed study of the variation of foF2 at ionospheric stations in the Asian zone shows that the region of maximum foF2 varies with the time of the day as well as with the season. The anomalous belt of the F2-layer develops at the equator near sunrise and slowly expands with the progress of the day, and is most extended during the afternoon hours. Multiple splittings in the F-region and other abnormal P′-f recordings observed at middle latitudes are shown to be associated with some striking features in the synoptic distribution of foF2. The abnormal recordings can be explained on the basis of horizontal movements in the ionosphere, being in the east-west direction before sunrise in the morning or after sunset in the evening, and in the north-south direction during the forenoon. *Subject Headings:* **1. F2 region 2. foF2 variations 3. Ionospheric movements.**—*Author's abstract.* Ⓢ

11.12–407 551.510.535:551.594.13

Rishbeth, H. and Barron, D. W. (*both, Cavendish Lab., Cambridge*), **Equilibrium electron distributions in the ionospheric F2-layer.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(2/3):234–252, June **1960.** 10 figs., 15 refs., 43 eqs. **DLC**—In the F-region of the ionosphere, the electron density is controlled by the production of ionization by solar radiation,

loss by recombination, and transport of ionization by electromagnetic drift movements and plasma diffusion. This paper is especially concerned with the factors which govern the F2-peak of electron density. An electronic computer has been used to solve the relevant equations for conditions of equilibrium, such as may be approached in the day-time F region. From the numerous examples considered, it is deduced that the maximum electron density, and the height at which it occurs, are such that the magnitudes of the production, loss and diffusion processes are approximately equal. The modifications produced by vertical electromagnetic drifts are discussed. Most of the work relates to the simple case of an isothermal atmosphere, but the conclusions derived are found to be substantially true for a few more general models which have been considered. *Subject Headings:* **1. Electron density in F2 region 2. Ionization balance.**—*Authors' abstract.* Ⓢ

11.12–408 551.590.24:551.510.535:551.594.13:541.14

Van Zandt, T. E.; Norton, R. B. and Stonehocker, G. H. (*all, Nat. Bu. of Stands., Boulder, Colo.*), **Photochemical rates in the equatorial F2 region from the 1958 eclipse.** *Journal of Geophysical Research*, Wash., D. C., 65(7):2003–2009, July **1960.** 3 figs., 17 refs., 6 eqs. **DLC**—The F2 region electron-density data from the eclipse on Oct. 12, 1958, at Danger Islands has been analyzed with a new method. It is shown that 1) temperature changes and transport of electrons were probably negligible during the eclipse, and 2) the rate of photoionization $q(h)$ and the linear recombination coefficient ('attachment coefficient') $\beta(h)$ can be approximated between 290 km and 400 km by

$$q(h) = 880 \exp\ [-(h-300)/186] \text{ electrons cm}^{-3} \text{ sec}^{-1}$$
$$\beta(h) = 6.8 \times 10^{-4} \exp\ [-(h-300)/103] \text{ sec}^{-1}$$

where the height h is measured in kilometers. The rate of formation of ion pairs between 290 and 400 km is $(.76)10^{10}$ ion pairs/cm² sec, or about (0.25) ergs/cm² sec. This implies a total rate of energy absorption in the F region of at least 2 ergs/cm² sec. *Subject Headings:* **1. Electron density in F2 region 2. Solar eclipse effects 3. Photochemistry of ionosphere.**—*Authors' abstract.* Ⓢ

11.12–409 551.510.535:551.594.12

Hill, G. E. (*A VCO Corp., Wilmington, Mass.*), **Anomalous foF2 variations in the Antarctic.** *Journal of Geophysical Research*, Wash., D. C., 65(7):2011–2023, July **1960.** 12 figs., table, 7 refs., 7 eqs. **DLC**—The daytime minimum in the F2 layer critical frequency, which is often observed in the Antarctic, is explained on the basis of a vertical shear in the horizontal wind (neutral air) and the resulting movement of charged particles in the presence of the Earth's magnetic field. The diurnal variation of the F2 layer critical frequency, as expressed by the noon minus the midnight value D, is normally positive, but in the case of the daytime minimum is negative. For a given month, the value of D was found to depend upon both the geographic latitude and the geomagnetic dip. The D values from the northern hemisphere were compared with the D values of the southern hemisphere for a time separation of 6 months. The comparison gave good agreement in the region of the graphs where there were stations for both hemispheres. (Owing to the asymmetry of the geomagnetic field, several stations in the southern hemisphere are found to have no corresponding stations in the northern hemisphere on the basis of geographic latitude and geomagnetic dip.) It was also noted that the negative D values occurred almost entirely in the southern hemisphere and in that region where there are no corresponding northern-hemisphere stations. A three-level model of the F region was developed for the purpose of demonstrating the effect of a vertical wind shear on the electron concentration. The results of electron-density computations for several cases showed that the characteristic F2 layer critical-frequency variations can be explained on the basis of a wind shear of the order of 25 to 50 m/s per 100 km. The wind shear can account for most of the 'anomalous' behavior in the Antarctic. *Subject Headings:* **1. foF2 variations 2. F2 anomalies 3. Ionospheric winds.**—*Author's abstract.* Ⓢ

11.12–410 551.510.535:551.594.13

†Johnson, Francis S. (*Lockheed Aircraft Corp., Calif.*), **The ion distribution above the F_2 maximum.** *Journal of Geophysical Research*, Wash., D. C., 65(2):577–584, Feb. **1960.** 3 figs.,

24 refs., 8 eqs. **DLC**—Observations of the ion distribution in the ionosphere indicate that the distribution up to 550 km is controlled in part by changes in the recombination rate with altitude, although diffusion exerts an increasingly important influence above the F_2 maximum. It is further concluded that the ion distribution above 550 km is controlled by diffusion and not by recombination, although a further reduction in recombination rate with increasing altitude does occur. Charge-exchange reactions between oxygen ions and hydrogen atoms at an altitude near the base of the exosphere provide a source of thermal protons which move upward along the magnetic field lines together with an equal number of electrons and produce a medium for the propagation of radio whistlers. The computed distribution of protons and electrons is in reasonable agreement with whistler observations. The whistler medium is of telluric origin, and the source of ionization is the same as that for the F region. It is suggested that the region above 1800 km in which protons predominate over all other ions be called the protonosphere, to distinguish it from the lower ionized region normally referred to as the ionosphere. *Subject Headings:* **1. Ion density 2. Whistlers 3. Ion diffusion.**—*Author's abstract.* Ⓢ

11.12–411 551.510.535:621.396.1

Ōse, Masami; Aida, Kazuo and Okamoto, Hironobu (*all, Radio Res. Labs., Kokubunji, Tokyo*), **Latitude dependence of *fo*F2 over the range of 20°N to 69°S, obtained by ship-borne ionospheric sounder.** *Journal of Atmospheric and Terrestrial Physics*, London, 15(1/2):130–131, Sept. **1959.** 3 figs. **DLC**—The results of magnetic dependence of *fo*F2 obtained from the routine ionospheric soundings on board the Soya as well as its course from Nov. 11, 1956 to April 21, 1957, are presented in two diagrams and a map. The normalized shape of the characteristics, free from the regular and irregular variations and longitudinal effects, depends on the availability of necessary hourly values throughout the world. *Subject Headings:* **1. *fo*F2 distribution 2. Ionospheric soundings 3. Latitude ionospheric variations.**—*O.T.* Ⓢ

11.12–412 551.510.535

Wright, J. W. (*Natl. Bur. of Stands., Boulder, Colo.*), **Comment on models of the ionosphere above $h_{max}F_2$** (*Summary only*). *Journal of Geophysical Research*, Wash., D. C., 65(9):2595–2596, Sept. **1960.** fig., 4 refs. **DLC**—Evidence for a gradient of scale height in the F region is shown, and discussed in relation to a simple Chapman model of the F region above $h_{max}F_2$[1]. It is suggested that a similar model but allowing for a scale-height gradient, may give somewhat better agreement with recent observations. *Subject Headings:* **1. Ionospheric models 2. F layer height.**—*Author's abstract.* Ⓢ

G. Ionospheric Movements

See also: **Moving irregularities in F region** (Khastgir, Singh), 11.12–395; **Abnormal features of F2 region** (Rastogi), 11.12–404; **Asymmetry between F2 region in northern and southern hemispheres** (Rastogi), 11.12–405; **F2 region in Asian zone** (Rastogi), 11.12–406; **F2 variations in Antarctic** (Hill), 11.12–409; **Movements of F layer during bay disturbances** (Kohl), 11.12–426.

11.12–413 551.510.535:551.557.3:551.594.13

†Kato, Susumu (*Dept. of Electronics, Kyoto Univ.*), **Ionized irregularities and wind motion in the ionosphere.** *Japan. Science Council. Ionosphere Research Committee, Report of Ionosphere and Space Research in Japan*, 13(1):62–78, **1959.** 7 figs., 2 tables, 15 refs., eqs. **DWB, DLC**—The motion of irregularities in the electron density in the ionosphere has been studied with a three dimensional model. The polarization field and the drift velocity of irregularities are calculated for various values of their electron density at certain heights. It is concluded that electrodynamic effects upon the motion of irregularities are only slight in the E-region under geomagnetically quiet conditions, whereas those effects become appreciably great in the F-region and even in the E-region in high latitudes under disturbed conditions. It should be noted that, due to action of the geomagnetic field, no irregularity moves without changing its form in a three-dimensional sense, decaying after a certain time depending upon its size. The minimum stable dimension of irregularities is estimated by taking the recom-

bination effect into account. Further a general discussion about stability is included for other models of irregularities. This study would provide one of the theoretical bases for "drift observation" conducted to investigate the wind motion in the ionosphere. It seems interesting at this stage of our knowledge to compare the wind systems deduced from the geomagnetic *Sq*-variations with those obtained from observation. This is attempted by using some observational material. *Subject Headings:* **1. Ionospheric electron density 2. Upper air wind variations 3. Ionospheric winds.**—*Author's abstract.* Ⓢ

11.12–414 551.510.535:551.594.13:551.557.2

Maeda, Hiroshi (*Dept. of Earth Science, Yoshida College, Kyoto Univ.*), **Horizontal winds and ionization drifts in the ionosphere.** *Japan. Science Council. Ionosphere Research Committee, Report of Ionosphere and Space Research in Japan,* 13(1):79–90, **1959.** 4 figs., 2 tables, 19 refs., 9 eqs. **DWB, DLC**—The relation between horizontal winds (air movements) and horizontal ionization drifts (layer drifts) in the ionosphere is studied on a basis of geomagnetic data during the International Polar Year, 1932–33. It is found that in the upper ionosphere (F-region) a wind is not efficient in producing drift of ionization, consequently the layer drift in this region is mainly due to an applied electric field. In the lower ionosphere (E- and D-regions), however. the induced and electrostatic fields are nearly equally efficient in producing drift, and the drift velocity due to these electric fields is very small, as compared with the wind velocity, so that it seems likely that the layer drift in E- and D-regions is almost the same as the air movement. *Subject Headings:* **1. Ionospheric drift 2. Ionospheric winds.** —*Author's abstract.* Ⓢ

11.12–415 551.510.535:551.594.13

Matuure, Nobuo (*Geophysical Inst., Tokyo Univ.*), **Some remarks on motion of ionospheric irregularity.** *Japan. Science Council. Ionosphere Research Committee, Report of Ionosphere and Space Research in Japan,* 13(1):4–20, **1959.** 2 tables, 3 refs., 47 eqs. **DWB, DLC**—Reprinted as *Tokyo Univ. Geophysical Institute, Geophysical Notes,* 12(2), **1959. DWB, DLC**—Agreement concerning the relation between the motion of ionospheric irregularity and that of surrounding ionized gas has been made for two cases in which the ionized gas has been treated as hydromagnetic fluid and as fully ionized gas. The particular motion of irregularity is possible for the case when the scale of the irregularity is larger than the order of 100 km. Motions of smaller scale irregularities are regarded as almost the same as that of surrounding positive ions. When the gas can be regarded as fully ionized, the particular motion of the irregularity is caused by gravitational force. This case corresponds to the higher part of the ionosphere where the particular motion of the irregularity of which the scale is smaller than the order of 1000 km is scarcely appreciable. *Subject Headings:* **1. Ionospheric disturbances 2. Ionospheric movements.**—*Author's abstract.* Ⓢ

11.12–416 551.510.535:551.544.13

†Shimazaki, Tatsuo (*Radio Research Lab.*), **World-wide measurements of horizontal ionospheric drifts.** *Japan. Science Council. Ionosphere Research Committee, Report of Ionosphere and Space Research in Japan,* 13(1):21–47, **1959.** 8 figs., 2 tables, 53 refs. **DWB, DLC**—In the first part of the present paper, existing radio methods of measuring horizontal drifts of anomalies of various kinds in the ionosphere are briefly summarized and a discussion of their merits and demerits is attempted. In the second part, the author gives daily variation curves of drift velocity obtained at various latitudes every season during IGY by the closely spaced receiver method. As a result, a somewhat systematic difference can be seen among daily variations observed at higher, middle, and lower latitudes and in different seasons for both E and F regions of the ionosphere. Then, these seasonal and latitudinal changes in daily variations are discussed in detail on the results obtained in the present study and in studies conducted by various workers in different years by the use of various methods of observation. Somewhat successful attempts are made to explain these observational results in the E and F regions. Special attention must be given to the fact that determination of ionospheric drifts in the F regions by the method of closely spaced receivers may suffer appreciably from the effect of movements of irregularities in the E region. *Subject Heading:* **1. Ionospheric drift measurements.**—*Author's abstract.* Ⓢ

11.12–417 551.557:551.510.535

Sprenger, K., **Die jahreszeitlichen Anomalien der Driftrichtung in der tiefen Ionosphäre nach Beobachtungen auf 245 kHz.** [Seasonal anomalies in drift direction in the low ionosphere according to observations at 245 kc/s.] *Zeitschrift für Meteorologie*, Berlin, 14(1):6–16, Jan. 1960. 9 figs., 5 refs. German and English summaries p. 6. **DWB, DLC**—Night-time drifts in the lower ionosphere, as detected by spaced receiver drift measurements in the low frequency region, are normally directed towards the east, in summer and winter. For a few weeks, however, there is, year by year, at fixed times during spring and autumn, a sudden reversal to the opposite direction, occuring every evening some time after sunset. This may be explained by a simultaneous existence of easterly and westerly wind systems spaced closely one above the other in the lower ionosphere, their height varying with time of day and season relative to the reflection height of 245 kc/s. *Subject Heading:* **1. Ionospheric drift directions.**—*Author's abstract.* Ⓢ

11.12–418 551.557:551.510.535

Ward, W. H. (*Dominion Physical Lab., Lower Hutt, New Zealand*), **E-region winds.** *Journal of Atmospheric and Terrestrial Physics*, London, 16(3/4):394–395, Nov. **1959.** 3 refs. **DWB, DLC**—This brief note, in the light of Greenhow and Neufeld's results, sets forth a few suggestions concerning the observations of E-region winds. The hypothesis that the E-region is heated by the sun is further discussed in order to explain the observed oscillations. It is shown that if the E-region is heated by the sun, there will be a net tendency for air to leave the sub-solar point. A mechanism is proposed to explain the prevailing wind as follows: air under the sun rises from the E-region and escapes, and once every two weeks the whole E-region comes in near the auroral zones and goes out in the tropics. *Subject Headings:* **1. E layer winds 2. Ionospheric winds.**—*I.S.* Ⓢ

11.12–419 551.557:551.510.535

Rawer, K., **Drift in the E region.** *Journal of Atmospheric and Terrestrial Physics*, London, 15(1/2):141–144, Sept. **1959.** 3 figs., 10 refs. **DLC**—Models to explain observations of shock waves are suggested, supposing for one of them a small deformation concentrated on a small surface and a narrow line of deformation going through the reflecting surface for the other one. To obtain for both models a spread distribution both in direction and amplitude a vertical component is inserted. Some results of observations at Neuf-Brisach in Oct. 1955 are presented. The statistical distribution of measured direction values shows a second, approximately opposite concentration whose different explanations suggest further investigation, intensified measurements and a model arrangement with more than three antennas. *Subject Headings:* **1. Ionospheric drift 2. E region 3. Neuf-Brisach, France.**—*O.T.* Ⓢ

11.12–420 551.501.81:551.510.535

Becken, J. and Maehlum, B. (*both, Norwegian Defence Res. Establishment, Norway*), **Drift measurements at Kjeller on the ionospheric F region.** *Journal of Geophysical Research*, Wash., D. C., 65(5):1485–1488, May **1960.** 7 figs., 12 refs. **DLC**—A study of the drifts and structure of the amplitude pattern of the F2 echo is presented. Some measurements on the sporadic F echo are also included. All the measurements were made at Kjeller, Norway. *Subject Headings:* **1. F layer drift 2. Kjeller, Norway.**—*Authors' abstract.* Ⓢ

11.12–421 551.510.535

Thomas, L. (*Dept. Physics, Univ. Coll. Swansea*), **Some measurements of horizontal movements in region-F2 using widely spaced observing stations.** *Journal of Atmospheric and Terrestrial Physics*, London, 14(1/2):123–137, April **1959.** 13 figs., 2 tables, 9 refs. **DLC**—The results of a study of horizontal movements in region-F2 using a system of stations spaced some 200 km apart are described. Vertical incidence recordings were used to study corresponding fluctuations at the three stations in the critical frequency and in the equivalent height of reflection at a fixed frequency. The measured velocities ranged from 40 to 280 m/sec and the direction of travel of the perturbations was mainly towards the south-east. A limited number of simultaneous observations at a station some 650 km north of the main group showed that these large-scale irregularities travel such distances with little change in direction but there is

clear evidence for larger velocities at more northerly latitudes. A comparison of the velocity magnitudes deduced from the two parameters (critical frequency and equivalent height) indicates a positive height-gradient of velocity of the order of 1 m/sec per km within region-F2. The results also suggest that the height gradient is larger in winter than in summer and larger near the lower edge of the layer than at the peak. Correlation, over both long and short periods, was observed between velocity magnitude and the degree of magnetic activity. *Subject Headings:* **1. F2 region 2. Ionospheric movements.**—*Author's abstract.* Ⓢ

11.12–422 551.501.81:551.510.535:551.510.62

Knecht, R. W. (*National Bureau of Standards, Boulder*), **Possibility of detecting ionospheric drifts from the occurrence of spread F echoes at low latitudes.** *Nature*, London, 187(4741): 927, Sept. 10, **1960.** 2 refs. **DLC** —Times of occurrence of spread F echoes on ionospheric soundings taken every 15 min. during Sept. and Oct. 1957 at four stations in Peru strongly suggest that the patches of irregularity thought to be producing the spread F were often observed successively at each of the four stations. Assuming that the drift was wholly in the magnetic east-west direction magnitudes of the east-west component of the apparent drifts have been estimated. The mean apparent drift velocity was obtained of 135 m/s towards the east for the period 0000–0400. *Subject Headings:* **1. Ionospheric drift 2. Spread F echoes.** —*R.B.* Ⓢ

11.12–423 551.510.535(94)

Heisler, L. H. (*Elect. Eng. Dept., Univ. Sydney*), **Occurrence of giant travelling ionospheric disturbances at night.** *Nature*, London, 183(4658):383–384, Feb. 7, **1959.** fig., 5 refs. **DLC** —Massive ionospheric disturbances travelling at 8–16 km/min through distances ranging from 1800 km to 3300 km have been observed at Brisbane (27°28′S, 153°2′E), Camden (34°03′S, 150°40′E) and Townsville (19°10′S, 146°58′E) in Australia during the daylight and night hours of some winter months. This phenomenon has also been observed in the U. S. Here it extends from the east to the west coast over distances of some 4000 km. *Subject Headings:* **1. Ionospheric disturbances 2. Australia 3. United States.**—*N.N.* Ⓢ

11.12–424 551.510.535:551.594.12:551.557.3

Gassmann, G. J. (*Ionospheric Physics Lab., GRD, AF Camb. Res. Center, Mass.*). **Tides in the F-layer.** *Journal of Atmospheric and Terrestrial Physics*, London, 15(1/2):99–101, Sept. **1959.** 2 figs., 5 refs. **DLC** —The analysis of the records of air-tides of Washington, Puerto Rico, Canal Zone, Talara, Huancayo, and of an air-borne equipment for the September 1955 period resulted in identification of a tidal wind system in the E region, and a system of separated charges in the E region as a by-product with the calculability of subsequent effects in the F-layer. The variations of levels of equal ionization and the change distribution in the E layer are illustrated by diagrams. *Subject Headings:* **1. E region 2. F layer tides 3. Ionospheric winds.**—*O.T.* Ⓢ

h. Relationships with Magnetic and Other Phenomena

See also: **Variation of useful frequencies as an effect of solar corpuscular radiation** (Lange-Hesse), 11.12–130; **Magnetic storm effects on F region** (Somayajulu), 11.12–393; **F2 region at southern high-latitude stations** (Rastogi), 11.12–404; **Heavy absorption in Arctic ionosphere** (Harang, Tröim), 11.12–439; **Ionospheric forward scatter mode associated with earth's magnetic field** (Heritage et al.), 11.12–443.

11.12–425 551.510.535:551.594.12:550.385.4

†Obayashi, Tatsuzo and Hakura, Yukio (*both, Radio Res. Labs., Kokubunji, Tokyo*), **Enhanced ionization in the polar ionosphere associated with geomagnetic storms.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(2/3):101–122, June **1960.** 11 figs., 21 refs., 15 eqs. **DLC**—New evidence indicating the existence of energetic solar particles associated with solar flares has been found from the analysis of world-wide data of f_{min} in the ionograms. An outstanding enhancement of ionization in the lower ionosphere occurs in the polar region with a delay of several hours after a large solar flare accompanied with major radio bursts of

type IV. Radio blackouts due to enhanced ionizations develop, spreading inside the whole polar cap without inducing any marked geomagnetic activity. With the onset of a geomagnetic storm, however, the blackout region spreads from the polar cap up to the so-called auroral zone. As the D_{st} field of geomagnetic storm develops, it comes down to considerably low latitudes forming a spiral-shaped ionization pattern. The radio blackouts, which precede the onset of geomagnetic storms, may be termed the polar cap blackouts because they are confined within the geomagnetic latitude of about 60–65°, while those related to geomagnetic storms and auroral displays are the auroral zone blackouts. It is shown that the polar cap blackouts are caused by the invasion of energetic particles of the order of 10–100 MeV, generated in an agitated solar coronal plasma bearing magnetic fields, and that those particles precipitate on the polar ionosphere following nearly the Störmer orbits. For the auroral zone blackouts, an improved version of the Störmer theory is applied, in which an interesting behavior of a charged particle in the distorted geomagnetic field is revealed. The remarkable equatorward shifting of the auroral zone and some peculiar increases of cosmic ray intensity during the main phase of magnetic storms are explained consistently by the decrease of geomagnetic cut-off for incoming particles owing to the contraction of the geomagnetic cavity. *Subject Headings:* **1. High energy particles 2. Polar blackouts 3. Geomagnetic storm effects on ionosphere.**—*Authors' abstract.* Ⓢ

11.12–426 551.510.535:550.385.36

Kohl, Harry, **Bewegungen der F-Schicht der Ionosphäre bei erdmagnetischen Bai-Störungen.** [Movements of the ionospheric F-layer during geomagnetic bay disturbances.] *Archiv der Elektrischen Übertragung*, Stuttgart, 14(4):169–176, April 1960. 7 figs., 9 refs., 24 eqs. German and English summaries p. 169. **DLC**—During positive geomagnetic bay disturbances a determination of the true height of the ionospheric F layer reveals that this layer rises. After the bay disturbance the layer sinks again. For an understanding of the first effect use can be made of the theory developed by D. F. Martyn for geomagnetic storms. That theory is further expanded, taking into account in particular the influence of the neutral gas. For the sinking of the layer under the influence of gravity and diffusion the motional equations of the plasma can be solved only approximately. The results of these considerations allow two applications. From the motion that is measured as the layer rises and simultaneously recorded geomagnetic bay disturbance, the integral of the ionospheric conductivity over the height can be calculated. From the sinking rate of the layer following the bay disturbance, the neutral gas density can furthermore be estimated approximately. In this manner there is found at Lindau for the conductivity integral over the height at about 23.00 h MET on January 13, 1958 $\int \sigma dh \approx 10^{13}$ cgs$\widehat{=}10\Omega^{-1}$ and for the neutral gas density at about 01.00 h MET on January 14, 1958 $\rho n \geqq 1.5.10^{-13}$ g cm^{-3} at a height of 350 km. *Subject Headings:* **1. F layer height-magnetic storm relationships 2. Magnetic effects on ionosphere.**—*Author's abstract.* Ⓢ

11.12–427 551.510.535:551.594.13

Croom, Sheila; Robbins, Audrey and Thomas, J. O. (*all, Cavendish Lab., Cambridge*), **Variation of electron density in the ionosphere with magnetic dip.** *Nature*, London, 185(4717): 902–903, March 26, **1960.** 2 figs., table, 5 refs. **DWB** —This paper describes how the average ionospheric electron density measured at local noon on quiet days in December 1957, at a series of fixed heights in the F region, varies with the magnetic dip. The winter or seasonal anomaly and the December or non-seasonal anomaly are discussed. *Subject Headings:* **1. Ionospheric electron density variations 2. Magnetic effects on ionosphere.**—*E.Z.S.* Ⓢ

11.12–428 551.510.535:551.521.64:550.385.4(98/99)

Obayashi, Tatsuzo (*Radio Res. Lab.*), **Entry of high energy particles into the polar ionosphere.** *Japan. Science Council. Ionosphere Research Committee, Report of Ionosphere and Space Research in Japan*, 13(3):201–219, **1959.** 14 figs., 23 refs., 37 eqs. **DWB, DLC** —An explanation is given for two types of enhanced ionizations in the polar ionosphere associated with geomagnetic storms, viz., the polar cap blackouts and the auroral zone blackouts. The former appears several hours after major type IV radio outbursts, yet, well before the onset of geomagnetic storms, while the latter is closely related to geomagnetic disturbances and auroral

displays. It is shown that the polar cap blackouts are caused by the invasion of energetic protons of 10∼100 MeV produced in the solar corona by an agitated plasma bearing magnetic fields, and that these particles precipitate into polar ionosphere following nearly the Störmer orbits. For the auroral zone blackouts, an improved version of Störmer's theory is applied, in which interesting behavior of a charged particle in the distorted geomagnetic field is revealed. The remarkable equatorward shifting of the auroral zone and world-wide increases of cosmic ray intensity during the main phase of geomagnetic storms are explained consistently by the decrease of geomagnetic cut-off for incoming particles owing to the contraction of the geomagnetic cavity. *Subject Headings:* **1. High energy particles 2. Polar blackouts 3. Geomagnetic storm effects on ionosphere.**—*Author's abstract.* Ⓢ

11.12–429 551.510.535:551.594.13:523.75

Harrison, V. A. W. (*Radio Res. Station, Slough*), **Ionospheric effects associated with the solar flare of July 10, 1959.** *Nature*, London, 186(4720):228-229, April 16, **1960.** 3 figs., 3 refs. **DWB**—On July 10, 1959, Sydney Observatory reported a class 3+ solar flare lasting from 0210 to 0410 U.T. The Cable and Wireless, Ltd., receiving station at Singapore also experienced a sudden fadeout of all radio circuits at 0210 U.T., the circuits not being reestablished until between 0415 and 0430 U.T. Ionospheric changes associated with the flare were observed at Singapore by using an automatic ionosonde. Calculations and deductions suggest that the enhanced ionization of the F2 layer on July 10 can reasonably be attributed to the effects of the solar flare. *Subject Headings:* **1. Solar flares 2. Solar-ionospheric relationships 3. F2 layer ionization variations.**—*E.Z.S.* Ⓢ

11.12–430 551.511.2:551.510.535:551.594.13

Macdonald, Norman J. and Knecht, Robert W., **Possible effect of lower atmosphere divergence on the local maximum electron density in the ionosphere.** Colorado. Univ. High Altitude Observatory. Institute for Solar-Terrestrial Research, Technical Report No. 8, March **1960.** 24 p. 18 figs., 12 refs., eq. **DWB** (M13.1 C719t). —A study was made of the possible relations of lower atmospheric parameters for several locations over North America and small scale variations of the local maximum electron density in the ionosphere, as measured by the radio penetration (critical) frequency. The results suggest that an increase (or decrease) of the critical frequency occurs depending on the magnitude and sign of the lower atmospheric divergence field. We speculate that the observed changes in critical frequency may be caused by a change in the divergence term in the equation of continuity for electron density in the ionosphere. *Subject Headings:* **1. Divergence effects on ionosphere 2. Ionospheric electron density variation.**—*Authors' abstract.* Ⓢ

I. Ionospheric Radio Wave Propagation

See also: **Solar radio emission and ionospheric damping in D layer** (Hachenberg, Volland), 11.12-53; **Radio noise absorption and F scatter** (Ramanathan, Bhonsle), 11.12-68; **Polar absorption event, May 1959** (Eriksen et al.), 11.12–74; **Variation of useful frequencies as an effect of solar corpuscular radiation** (Lange-Hesse), 11.12–130; **Propagation of radio waves by means of meteorites** (Roessler), 11.12-162; **Synchrotron radiation from Van Allen belts** (Dyce, Nakada), 11.12–272; **Radio noise from upper atmosphere; whistlers** (Section B5), 11.12–319 to 11.12–336; **Oblique-incidence sporadic E and F-scatter program** (Finney, Smith), 11.12–339; **Electromagnetic wave propagating through an ionized layer** (Meynieux), 11.12–346; **Recording type direction finder** (Miya, Matsushita), 11.12–351; **Rocket measurement of electron densities** (Berning), 11.12–353; **Electron densities utilizing high-altitude rockets** (Haycock et al.), 11.12–357; **Rocket studies of Arctic ionosphere** (Seddon, Jackson), 11.12–362; **Satellite measurements of ionosphere** (Section B6d), 11.12–364 to 11.12–379; **Transparency of Es layer** (Rawer), 11.12–390.

11.12–431 551.510.535:538.69:532.59

Kahalas, Sheldon L. (*Allied Research Associates Inc., Boston, Mass.*), **Magnetohydrodynamic wave propagation in the ionosphere.** *Physics of Fluids*, N. Y., 3(3):372–378, May/June, **1960.** 3 figs., 19 refs., 30 eqs. **DWB**—The propagation of magnetohydrodynamic waves

in a compressible fluid is discussed with reference to the ionosphere. An investigation of the damping for a gas of finite conductivity shows that different wave modes may be heavily attenuated in certain directions of propagation. Also, the slow wave of the magneto-acoustic mode is shown to exhibit preferentially less damping for propagation along the magnetic field lines. An examination of the Hall and electron pressure terms shows that they may be neglected for low enough wave frequencies. The coupling of electromagnetic to magneto-hydrodynamic waves at a plasma-vacuum boundary is considered. The coupling coefficient is estimated to be 1%. *Subject Headings:* **1. Ionospheric waves 2. Magnetohydrodynamic waves.**—*Author's abstract.* Ⓢ

11.12–432 551.510.535:538.69:532.59

†Fejer, J. A. (*Defence Res. Board, Ottawa*), **Hydromagnetic wave propagation in the ionosphere.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(2/3):135–146, June 1960. 26 refs., 44 eqs. **DLC**—The dispersion equation of hydromagnetic waves, including the effects of collisions, is obtained for an arbitrary angle between the direction of propagation and the direction of a primary magnetic field assuming certain approximations usually valid in the terrestrial ionosphere. Special cases of the general dispersion equation are considered and some well-known results are regained. Expressions for the dissipated power are derived. The propagation of hydromagnetic waves in a horizontally-stratified ionosphere is discussed, by analogy with the propagation of very-low-frequency radio waves. *Subject Headings:* **1. Hydromagnetic waves in ionosphere 2. Ionospheric VLF propagation.**—*Author's abstract.* Ⓢ

11.12–433 621.396.1:551.510.535 550.385:550.383

Titheridge, J. E. (*Auckland Univ. Coll., New Zealand*), **Ray paths in the ionosphere: approximate calculations in the presence of the earth's magnetic field.** *Journal of Atmospheric and Terrestrial Physics*, London, 14 (1/2):50–62, April 1959. 5 figs., table, 9 refs., 23 eqs. **DLC**—Expressions are derived from which it is possible to plot approximate ray paths through "linear" or "parabolic" ionospheric layers in the presence of the earth's magnetic field. From the curves of Figs. 3, 4 and 5 it is possible to compute very simply the horizontal displacement of the reflection point for any dip angle, and for vertical or oblique incidence. *Subject Headings:* **1. Geomagnetic field 2. Ionospheric radio wave propagation.**—*Author's abstract.* Ⓢ

11.12–434 551.510.535:551.510.62:621.396.1

Johler, J. Ralph and Walters, Lillie C., **On the theory of reflection of low- and very-low-radiofrequency waves from the ionosphere.** *U. S. National Bureau of Standards, Journal of Research, Sec. D (Radio Propagation)*, 64(3):269–285, May/June 1960. 32 figs., 13 refs., 84 eqs. **DWB, DLC**—The rigorous application of the magneto-ionic theory to the calculation of reflection coefficients for a sharply bounded ionosphere model is carried out. The paper is illustrated with computations applicable to the D-region or the E-region of the ionosphere. The quasi-longitudinal approximation is derived from this theory and the range of validity of this approximation is illustrated. The restrictions imposed by the use of a sharply bounded model ionosphere are discussed. *Subject Heading:* **1. Ionospheric radio wave reflection.**—*Authors' abstract.* Ⓢ

11.12–435 551.510.536:551.594.12:621.396.1

Obayashi, Tatsuzo (*Radio Res. Lab.*), **A possibility of the long distance HF propagation along the exospheric field-aligned ionizations.** *Japan. Science Council. Ionosphere Research Committee, Report of Ionosphere and Space Research in Japan*, 13(3):177–186, 1959. 9 figs., 7 refs., 10 eqs. **DWB, DLC**—Transequatorial very long range echoes of the order of 7000 km detected by the HF back-scatter sounder at Hiraiso are interpreted as the ground backscatter propagation launched on the path along the exospheric field aligned ionizations. Ray path calculation on this longitudinal mode of propagation between the geomagnetically conjugate points along its field line is made for various geomagnetic latitudes. The expected echo distance agrees well with that obtained by the experiments. It is also found that the average exospheric electron density deduced from the observed echo spreads is about $10^3 \sim 10^5$ electrons per cm^3. A possible use of this propagation mode of backscatter as a tool of exospheric

sounding is suggested. *Subject Headings:* **1. Radio wave propagation over long distances 2. Exospheric ionization.**—*Author's abstract.* Ⓢ

11.12–436 551.510.535:621.396.1

Muldrew, D. B. (*Defence Res. Telecomm. Establ, Ottawa*), **Ionospheric ray-tracing technique and its application to a problem in long-distance radio propagation.** *Institute of Radio Engineers, Transactions on Antennas and Propagation*, Vol. AP-7(4):393–396, Oct. **1959.** 9 figs., 4 refs., 20 eqs. **DLC**—A method is given for the determination of the equation of a ray path in a known ionosphere where there are no horizontal gradients. It can partially take into account the effects of the magnetic field of the earth. The method was applied to an oblique path between Ottawa and Slough (5300 km) to determine certain properties of the one-hop mode. From this it is shown that at times one hop direct ray propagation is possible over this path. *Subject Headings:* **1. Ray tracing techniques 2. Radio wave propagation over long distances 3. Ionospheric radio wave propagation.**—*Author's abstract.* Ⓢ

11.12–437 551.510.535:551.510.62

Chatterjee, B. (*Indian Inst. of Technology, Kharagpur, India*), **A note on fourth reflection condition in the ionosphere.** *Journal of Atmospheric and Terrestrial Physics*, London, 17(4): 271–275, Feb. **1960.** 2 figs., 6 refs. **DLC**—The phenomenon of no reflection at $\mu = \infty$ can be explained by "ray treatment." When the value of μ becomes infinity the wave moves normally into the layer at an infinitely slow rate. Thus the wave remains "trapped" inside the given layer for an indefinitely long time (t), and any finite rate of dissipation (finite value of v) – however small—will be able to dissipate the whole energy inside the layer. As the value of v in a material medium can never be zero and the value of t is infinitely large in this particular case, the absorption of wave energy is also infinitely large. As a result, the whole of extraordinary wave energy under this condition gets dissipated in the layer and no reflection of wave energy can take place. This accounts for the so-called "absorption band" at this frequency. *Subject Heading:* **1. Ionospheric radio wave reflection.**—*E.Z.S.* Ⓢ

11.12–438 551.510.535/6:551.594.12

Dyce, R. B. (*Stanford Res. Inst., Menlo Pk., Calif.*), **Faraday rotation observations of the electron content of the exosphere** (*Summary only*). *Journal of Geophysical Research*, Wash., D. C., 65(9):2617–2618, Sept. **1960.** table, 4 refs. **DLC**—The polarization twist imposed on 106.1-Mc/s radio waves by the ionosphere has been investigated by using the moon as a passive reflector. This has been done with a view to learning the total electron column density even at altitudes above the known ionosphere. Because the antenna is capable of being continuously directed at the moon for 12 consecutive hrs, observations are possible from the predawn ionization minimum to the noontime maximum. *Subject Headings:* **1. Ionospheric electron density 2. Ionospheric radio wave polarization.**—*Author's abstract.* Ⓢ

11.12–439 551.590.25:551.510.535:551.510.62

Harang, L. and Tröim, J. (*both, Norwegian Defence Res. Estab., Kjeller, Norway*), **An example of heavy absorption in the VHF-band in the Arctic ionosphere.** *Planetary and Space Science*, N. Y., 1(2):102–104, April **1959.** 3 figs., ref. **DWB**—From records of meteor echoes on 40 Mc/s and of scintillations from the Cassiopeia source on 45 Mc/s it is shown that on 7 July 1958 in the early morning hours a very heavy absorption appeared. The meteor echoes disappeared completely and the radiation from Cassiopeia diminished to less than $\frac{1}{3}$ of its normal value. The observations were made at Tromsö ($\phi = 70°$N) and in the direction towards the auroral zone. A great geomagnetic storm appeared with a sudden commencement at 08.40 MET, the geomagnetic storm started about 5 hr after the absorption effect of the ionosphere had started. *Subject Headings:* **1. Ionospheric absorption 2. Meteor echoes 3. Tromsö, Norway.**—*Authors' abstract.* Ⓢ

11.12–440 551.501.81:551.510.535

Taubenheim, J., **Incoherency of pulse echoes and the measurement of ionospheric absorption.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(2/3):147–151, June

1960. 3 figs., 6 refs., 13 eqs. **DLC**—The presence of incoherently scattered energy in the h.f. pulse echoes from the ionosphere gives rise to errors in the absorption value determined from the median echo amplitude. These errors are larger for the second-order than for the first-order echo. The calculations are confirmed by experimental results. *Subject Headings:* **1. Ionospheric absorption calculation 2. Pulse soundings.**—*Author's abstract.* Ⓢ

11.12–441 551.510.535:551.510.62:621.396.9

Dasgupta, P. and Vij, K. K. (*both, All India Radio, New Delhi*), **Statistical analysis of fading of a single down-coming wave.** *Journal of Atmospheric and Terrestrial Physics*, London, 18(4):265–275, Aug. **1960.** 9 figs., 9 refs., 16 eqs. **DLC**—The paper deals with the statistical analysis of fading of a single wave reflected (vertically) from the F-region of the ionosphere. These fading records are usually random and their amplitude distribution has been found by other workers to be Rayleigh, Gaussian or log-normal. The present analysis shows that the amplitude distribution is Rayleigh only in the case of rapid fading, whereas for slow and quasi-periodic fading it is found to represent what can be termed as an M-type. The distribution of successive differences in the amplitudes has also been studied; for a Rayleigh amplitude distribution this time analysis gives rise to a Type-Vii distribution of PEARSON as originally pointed out by MITRA (1949) while in the case of M-type amplitude distribution it becomes Gaussian. Following MITRA's analysis, the r.m.s. value of the random velocity, v_0 of the ionospheric irregularities has been calculated from the time analysis. The value of v_0 has also been calculated from the autocorrelation coefficient of the amplitude R following BOOKER et al. (1950). The two values of v_0 thus obtained are compared and are found to agree well. *Subject Headings:* **1. F region 2. Radio fading 2. Ionospheric radio wave reflection.**—*Authors' abstract.* Ⓢ

11.12–442 551.510.535:621.396.8:551.510.62

Pineo, V. C.; Kraft, L. G. and Briscoe, H. W. (*all, Lincoln Lab., M. I. T.*), **Ionospheric backscatter observation at 440 Mc/s.** *Journal of Geophysical Research*, Wash., D. C., 65(5): 1620–1621, May **1960.** 3 figs., 3 refs. **DLC**—Backscatter returns have been observed at heights ranging from under 100 km to about 800 km. They resemble noise when viewed on an A-scope display of the receiver output. The highest signal-to-noise ratios are obtained with the antenna beam pointing vertically upward but the signal intensities are usually high enough to be observed down to elevation angles as low as 15°. Operation at low elevation angles has made it possible to obtain returns from E region heights. Signal-to-noise ratios versus height profiles taken at 90° and 15° are given as experimental results. *Subject Heading:* **1. Ionospheric radio wave scattering.**—*E.S.* Ⓢ

11.12–443 621.396.8:551.510.535:550.388

Heritage, J. L.; Weisbrod, S. and Fay, W. J. (*all, Smyth Res. Associates, San Diego, Calif.*), **Evidence for a 200 megacycles per second ionospheric forward scatter mode associated with the earth's magnetic field.** *Journal of Geophysical Research*, Wash., D. C., 64(9):1235–1241, Sept. **1959.** 8 figs., 4 refs. **DLC**—In July 1958, two experiments were carried out to study the gross features of an ionospheric scatter mode observed at 200 Mc in the southwestern United States. The transmitter was pulsed and high powered; transmission took place during alternate 1-min periods on one of two pencil beams, differing in azimuth by 5°. The direction of transmission was southeast to northwest; and the hot spots, or areas of strong illumination in the E layer, were about 850 km from the transmitter. Contours representing specular reflection from earth magnetic field lines passing through the hot spots were calculated. In the first experiment one mobile receiver was positioned on the specular contour for each beam. Both receivers were well south of the great-circle paths. As the beams were switched, the level of the scatter signal changes in antiphase at the two receivers, suggesting that the scattered energy is fairly sharply peaked about the specular contour. The scatter signal was characterized by rapid fading and broad angle of arrival in azimuth. The second experiment used one receiver on the great-circle path and the other on one of the specular magnetic field contours. No scatter-type signals were observed on the great circle; the station located on the magnetic contour showed the usual rapid-fading scatter signals. *Subject Headings:* **1. Ionospheric radio wave scattering 2. Magnetic effects on ionosphere.**—*Authors' abstract.* Ⓢ

11.12–444 551.510.535:551.510.62:621.396.8

Morris, D. W. and Hughes, C. J. (*Post Office Eng. Dept. Res. Station, Dollis Hill, London*), **Phase characteristics of radio signals received via the ionosphere.** *Nature*, London, 183(4657): 310–311, Jan. 31, 1959. 2 figs., 6 refs. **DLC**—When a radio wave is reflected from the ionosphere it consists of a specular component, and a varying diffracted component. The latter is the result of random scattering from a large number of moving irregularities. A description of the theoretical and measured phase probability distributions is made. The analyser which was used has the advantage of high rate sampling of the several different aerial spacings to be determined before the effects of the ionospheric tilting that produce significant changes in the statistical properties of the signal. *Subject Headings:* **1. Ionospheric radio wave reflection 2. Ionospheric tilt.**—*N.N.* Ⓢ

11.12–445 551.506.22:551.510.535:551.510.62(5-012)

Smith, Ernest K., Jr. and Finney, James W. (*both, Natl. Bureau of Stands., Boulder, Colo.*), **Peculiarities of the ionosphere in the Far East: a report on IGY observations of sporadic E and F-region scatter.** *Journal of Geophysical Research*, Wash., D. C., 65(3):885–892, March 1960. 9 figs., table, 7 refs. **DLC**—This paper considers the results for the period October 1, 1957, to October 1, 1958, from the IGY "VHF oblique-indicence sporadic-E measurements" program which operated circuits at 50 Mc/s in the Far East and the Caribbean. Sporadic E is found to be three to five times more frequent in the Far East than in the Caribbean for reflection coefficients of −20 to −80 db relative to inverse distance. Negligible dependence of magnetic activity is observed in either area, but diurnal and seasonal variations are more regular in the Far East. It is suggested that this longitudinal difference may be due either to the influence of the East Asiatic monsoon, perhaps through the mechanism proposed by MARTYN, or to the difference in the relationship of magnetic dip to geographic latitude in these two areas. A peculiar evening signal enhancement, referred to as the "Far Eastern anomaly" or the "evening signal anomaly," appeared quite regularly in the Far East, and pulse-delay measurements indicate the probable source of the reflection to be the F region. The corresponding effect in the Caribbean is about 100 times less frequent, if it exists at all. The ⁿF (layer tilt) reflection mechanism proposed by workers at Stanford does not appear too promising in this case, owing to the pulse broadening of the order of 1 millisecond which is normally encountered in the evening signal anomaly. A mechanism that would explain the structure of the observed signal involves reflection from field-aligned ionization similar to the mechanism invoked to explain the "low-latitude auroral echoes" observed at Stanford. *Subject Headings:* **1. Sporadic E layer (Es) 2. IGY ionosphere program 3. Ionospheric radio wave scattering 4. Far East.**—*Authors' abstract.* Ⓢ

11.12–446 551.510.535:551.594.13:621.396.1

Wait, James R. (*Natl. Bureau of Stands., Boulder, Colo.*), **On the propagation of ELF radio waves and the influence of a nonhomogeneous ionosphere.** *Journal of Geophysical Research*, Wash., D. C., 65(2):597–600, Feb. 1960. 3 figs., 6 refs., 8 eqs. **DLC**—The model assumed consists of a spherical earth surrounded by a concentric ionosphere whose electron density increases exponentially with height. This elaboration of the usual homogeneous model appears to explain the observed attenuation for terrestrial propagation as a function of frequency in the range 100 c/s to 1 kc/s. *Subject Heading:* **1. Ionospheric radio wave propagation.** —*Author's abstract.* Ⓢ

11.12–447 551.510.535:551.594.13:621.396.11

Proverbio, E. (*Osservatorio Astronomico di Brera-Milano*), **Sull'irregolarità di ricezione dei segnali orari ad onde corte.** [Irregularity of the reception of short-wave hourly signals.] *Annali di Geofisica*, Rome, 12(4):535–548, Oct./Dec. 1959. 3 figs., 3 tables, 6 refs., eqs. Italian, French and English summaries p. 547–548. **DLC**—The importance of the problem of the time signal transmissions and, particularly, of the problem of the variations of the intensity of reception and its possible causes (such as seasonal and diurnal electron density variations in the E and F1 layers; irregular F2 variations; SID's; and interference) are shown. *Subject Headings:* **1. Ionospheric electron density variation 2. Short wave radio propagation.** —*Author's abstract.* Ⓢ

7. OZONE LAYER

11.12–448 551.510.534:061.3(473)

Kuznetsov, G. I., **Vsesoiuznaia konferentsiia po atmosfernomu ozonu.** [All-Union Conference on atmospheric ozone.] *Meteorologiia i Gidrologiia*, Leningrad, No. 2:58–59, Feb. **1960. DWB, DLC**—Minutes of the conference that took place in October 1959 in the Moscow State University and was called together by the Ministry of Special Education USSR, the Main Administration of the Hydrometeorological Service USSR, and the USSR Academy of Sciences. It was attended by representatives of 17 organizations, 21 reports were presented dealing with three main problems: 1) methods of studying the total context and the vertical distribution of ozone, its temperature, etc., 2) the theory of the formation and changes of atmospheric ozone; and 3) the relationship between atmospheric ozone and the meteorological parameters of the atmosphere and synoptic conditions. *Subject Headings:* **1. Ozone conferences 2. Moscow, U.S.S.R.**—*A.M.P.* Ⓢ

11.12–449 551.508.952

Brewer, A. W. and Milford, J. R. (*both, Clarendon Laboratory, Oxford*), **The Oxford-Kew ozone sonde.** *Royal Society of London, Proceedings, Ser. A*, 256(1287):470–495, July 19, **1960.** 17 figs., 15 refs., eqs. **DLC** (Q41.L7), **DWB**—An ozone sonde capable of measuring and transmitting the local ozone concentration has been developed for the IGY and is described in some detail. A continuous electrochemical detector measures the ozone concentration, providing a d.c. electric current of 0 to 5μA according to the amount of ozone in the air passed through it. This output current is telemetered by a current-controlled variable inductance which is interchangeable with a standard inductance coil in a Kew radiosonde. The element is of low cost, weighs about 600 g and requires very limited auxiliary equipment for its use. Sixty-five successful ascents have been made and the results of the European ascents are given. *Subject Heading:* **1. Ozonesondes.**—*Authors' abstract.* Ⓢ

11.12–450 551.510.41:546.214 551.510.534

Horiuchi, Goji (*Meteor. Training School, JMA, Kashiwa*), **A possible interpretation on the meridional distribution of atmospheric ozone.** *Geophysical Magazine*, Tokyo, 29(4):531–534, March **1960.** 2 figs., table, 12 refs. **DWB, DLC**—With reference to RAMANATHAN'S recent paper (1954) it is considered possible to assume that the temperature dependence of equilibrium ozone amount and the air mass excess in the winter hemisphere play an important part in the meridional distribution of atmospheric ozone. In order to illustrate this the vertical temp. distribution in several latitudes assumed by some model atmospheres and observations is graphically presented. The photochemically calculated height distribution of mesospheric ozone is also graphically presented. Meridional distribution of atmospheric ozone is tabulated. *Subject Headings:* **1. Ozone distribution 2. Meridional transport of ozone.**—*I.S.* Ⓢ

11.12–451 535.242:551.593.55:551.521.3:551.510.534

Vivari, N. B., **O tsvete sumerechnogo neba v zenite.** [Light of the twilight sky in the zenith.] *Akademiia Nauk Kazakhskoĭ SSR. Astrofizicheskiĭ Institut, Izvestiia*, 9:106–107, **1959.** 10 figs., 8 tables, 14 refs., 5 eqs. English summary p. 107. **DLC**—The results of photoelectric observations of the energy distribution in the spectrum of the light of the zenith twilight are presented. The observations were made by a photoelectric photometer in combination with interference filters of the multiplier narrow band type, centered to the following wavelengths: 367, 369, 405, 437, 554, 580 and 593 mμ. It is shown, that the observed energy distribution in the twilight radiation is due to ozone absorption in the Chappuis band. The comparison of the observed intensities of the zenith twilight with those theoretically computed, taking into account only diffusion of the first order is made. The intensity of the observed radiation for all wavelengths of the visible part of the spectrum is very close to the intensity of diffuse radiation of the first order for sun zenith distances from 90° to 96°.5 only. At larger sun zenith distances the observed intensities are higher than those computed theoretically. An explanation of the variations of the blue-red intensity ratio is given. These variations are due to ozone absorption in the Chappuis band and to the difference of the height of the so-called "effective rays" for the different wavelengths of observed light. *Subject Headings:*

1. Zenith twilight 2. Twilight radiation 3. Photoelectric photometry 4. Ozone absorption. —*Author's abstract.* Ⓢ

11.12–452 551.510.534:551.524.7:551.557(52)

Ikeda, H. (*Aerological Obs.*), **On the correlation between the total amount of ozone and the other meteorological elements at Tateno.** *Tateno, Japan. Aerological Observatory, Journal*, 6(4):191–203, Jan. **1960.** 5 figs., 4 tables, 10 refs. English and Japanese summaries p. 191. **DLC**—The statistical relationships between the total amount of ozone and the temperature and wind in upper atmosphere at Tateno, are considered. It is found that high correlations of ozone with temperature exist at about 100 and 400 mb with positive and negative signs respectively. Moreover the results are compared with those of Tromsö and Oxford, and a rough estimate of advection over Tateno is made, using data of Sapporo and Torishima. The correlation of ozone with observed wind at 200 mb is not distinct but it is shown that the maximum of ozone and that of temperature at 100 mb appear with troughs at 200 mb. Day-to-day variation of ozone is shown together with the time section of meridional distribution of temperature and wind velocity. *Subject Headings:* **1. Ozone distribution in upper atmosphere 2. Upper air ozone-temperature-wind correlations 3. Tateno, Japan.**—*Author's abstract.* Ⓢ

11.12–453 551.510.534:551.509.3:541.14

Bozhkov, Rumen D., **Ozonŭt i vrŭzkata mu s atmosfernite protsesi.** [Ozone and its connection with atmospheric processes.] *Khidrologiia i Meteorologiia*, Sofia, No. 2:13–23, **1959.** 3 figs., 9 refs. Russian and English summaries p. 22. **DLC**—After a historical review of the problem of ozone in the atmosphere, a critical survey is made of the present knowledge of its formation, distribution and concentration in height. Chapman's view of photochemical equilibrium is discussed in great detail, and some considerations of the temperature influence according to Nicolet and Vassy are reviewed. The connections between nonperiodic changes in ozone content and atmospheric processes are discussed with a view to the possibility of using them in weather forecasting. *Subject Headings:* **1. Ozone 2. Photochemical equilibrium of ozone.**—*Author's abstract.* Ⓢ

C. SPACE EXPLORATION, ASTRONAUTICS

1. GENERAL

See also: **Literature for 1957** (Astron. Yearbook), 11.12–7.

11.12–454 551.507.362:613.693

Tobias, Cornelius (*Donner Lab. Calif. Univ., Berkeley*), **Space science.** *Science*, Wash., D. C., 129(3353):906–910, April 3, **1959.** **DLC**—At the second international Symposium on Physics and Medicine of the Atmosphere and Space held in San Antonio, Texas, on Nov. 10–12, 1958, over 600 scientists and scientific leaders of government agencies discussed interplanetary physics and chemistry, the factors in space that are of importance to biology and medicine, satellite physics and engineering, problems of escape and rescue in space operations, human factors, and solar and planetary environments. Some of the findings are discussed in this communication. *Subject Headings:* **1. Interplanetary flights 2. Space science conferences 3. Space medicine.**—*N.N.* Ⓢ

11.12–455 551.507.362:629.19

Research in space. *Science*, Wash., D. C., 130(3369):195–202, July 24, **1959.** figs. **DLC**—An article introducing the Space Science Board of the National Academy of Sciences and reviewing the opportunities available for experimentation in space. The Board was established on 2 August 1958 for the purpose of ensuring the constructive support of the scientific community for programs of scientific research in space. The article also outlines some pertinent information in this respect under the heads: vehicular reliability, weights and volume, power, environmental temperatures, shock and vibration, telemetry and tracking. Numerous

photographs illustrate the discussion. *Subject Headings:* **1. Space exploration 2. Astronautics.** —*I.S.* Ⓢ

11.12–456 551.510.536:629.19:061.3

U. S. Congress. House. Committee on Astronautics and Space Exploration, **The next ten years in space, 1959–1969.** Staff report of the . . . Committee. 86th Congress, 1st session, **1959.** 221 p. figs., tables. (House Document No. 115.) **DWB** (629.1388 U581ne) —To learn what discoveries and advances may be ahead in the new space age, the House Select Committee on Astronautics and Space Exploration undertook to sample informed opinion. Requests for information and predictions in this field were dispatched to eminent authorities in the U. S., Great Britain, Germany, Italy, and the Far East, to American corporations engaged in space projects, to U. S. military leaders and to government agencies. The experts were asked what they see in the future for space development —and particularly what scientific progress they think may evolve in the next 10 years. Answers to the various questions allied with the space age are contained in the accompanying replies from half a hundred of the most knowledgeable of today's space authorities. Names and identification of these contributors are also listed. The report also contains tables, graphs and photos to illustrate the various discussions. A review of the different aspects of the space field and of replies precedes the actual answers received from the experts. *Subject Headings:* **1. Outer atmosphere investigations 2. Astronautics 3. Space exploration.**—*I.S.* Ⓢ

11.12–457 551.507.362:061.3(73)

Newell, H. E., Jr. (*National Aeronautics and Space Administration*), **The United States programme in space research.** *Royal Society of London, Proceedings, Ser. A,* 253(1275):538–541, Dec. 29, **1959. DWB**—The National Aeronautics and Space Administration (NASA), created by the National Aeronautics and Space Act in 1958, plans to continue the use of sounding rockets and satellites in exploring the earth's atmosphere and the space beyond. Some of the areas of major scientific interest include: atmosphere, ionosphere, high-energy particles, fields (gravitational, magnetic, electric), photons, astronomy and controlled experiments. *Subject Headings:* **1. Space exploration 2. Rocket exploration of the upper atmosphere 3. Astronautics 4. United States.**—*E.K.* Ⓢ

11.12–458 550.3 52 551.510.53:629.19:061.6(73)

NASA space sciences program. *Astronautics,* N. Y., 4(7):36–42, July **1959. DLC**—A detailed account is given of the activities of National Aeronautics and Space Administration. The NASA is working with the advice of some of the top specialists in the country. The subject of research in space is divided into several branches such as atmospheres, ionospheres, energetic particles, electric and magnetic fields, gravitational fields, astronomy and biosciences. The principal scientific objectives are stated. The program is subject to continuous review. *Subject Headings:* **1. Astronautics research and development 2. U. S. National Aeronautics and Space Administration.**—*A.H.K.* Ⓢ

11.12–459 629.19:061.3

U. S. National Aeronautics and Space Administration. **First Semiannual Report to the Congress, Oct. 1, 1958–March 31, 1959.** Wash., D. C., **1959.** 91 p. Price: $0.50.—The achievements of the civilian oriented aeronautical and space program of the U. S. during the first 6 months of NASA's existence is presented in this report. After the introduction, Ch. II describes the NASA highlights during the period Oct. 1, 1958–March 31, 1959; Ch. III contains comprehensive information about achievements and programs in different fields; Ch. IV treats NASA—its organization and functions; Ch. V covers other activities. *Subject Heading:* **1. U. S. National Aeronautics and Space Administration.**—*E.K.* Ⓢ

11.12–460 551.510.53:629.19:06.045

Soviet bloc and West accept plan for space research. *Science,* Wash., D. C., 131(3395): 210–211, Jan. 22, **1960. DLC**—A report of the agreement reached between the Soviet bloc and the Western nations to cooperate on problems of space science within the framework of the Committee on Space Research (COSPAR). The representation on the Committee consists of

a seven-man inner cabinet, or bureau—the president of the Committee and six other members. These members, like the president are elected to office, but with this restriction that there must be a balance between East and West in the nationalities of the six members elected. Presently, three members are from the Soviet Union, Czechoslovakia and Poland and three from the United States, Great Britain and France. H. C. Van Der Houlst of the Netherlands, who announced the agreement on Jan. 9, is the president of the committee. *Subject Headings:* **1. Astronautics research and development 2. International cooperation in space research.**—*I.S.* Ⓢ

11.12–461 551.510.53:551.507.362:061.3

International Scientific Radio Union, **Les Nations Unies et les recherches spatiales.** [The United Nations and space research.] Its *Bulletin d'Information*, No. 118:5–92, Nov./Dec. **1959.** —This article contains large excerpts from a report drawn up by the General Secretary of the United Nations, and from the Proceedings of the Special Committee for the Pacific Use of the Extra-Atmospheric Space. These accounts relate to the General Assembly of the United Nations held in New York in 1959, where a large place was given to the activities of the international scientific unions and particularly to the cooperation which could exist between these unions and the Organization for the Pacific Use of the Extra-Atmospheric Space. The paper includes three chapters: the first concerns space research, gives a very succinct historical survey of space exploration, examines the possibilities offered by sonde rockets, artificial satellites of the earth and cosmic engines; and exposes the various aims of space research. Chap. II deals with international scientific cooperation in general and nongovernmental international scientific organizations; and Chap. III describes the role of the UN and of the specialized organizations. *Subject Headings:* **1. Space research 2. Rockets 3. Satellite observatories 4. International co-operation in space exploration.**—*A.V.* Ⓢ

11.12–462 551.510.536:061.3(492.6)

International Council of Scientific Unions. Committee on Contamination by Extra-Terrestrial Explorations, **Summary recommendations of Second meeting, The Hague, March 9–10, 1959.** *Planetary and Space Science*, N. Y., 1(3):249–251, Aug. **1959. DWB**—In the interval between the first and second meetings of CETEX, a new body COSPAR has been formed by ICSU to coordinate world-wide space research. It enjoys the support of the American and Russian academies; feeling that the detailed functions proposed for its second meeting form an integral and important part of the duties of COSPAR, at this second meeting CETEX confined itself to the general formulation of the problem and review of its initial report; which has been slightly modified. The present paper gives a report of the meeting and describes briefly its recommendations. The second meeting was held in the Hague on March 9–10, 1959. Professor Marcel Florkin served as convener. The other participants were 5 representatives and 2 observers. The recommendations cover 1) general principles governing space research, 2) contamination endangering physical and chemical studies, 3 and 4) biological contamination. *Subject Headings:* **1. Space science conferences 2. Outer atmosphere investigations 3. The Hague, Netherlands.**—*I.S.* Ⓢ

11.12–463 551.510.53:629.19(44)

Vassy, Etienne (*Univ. of Paris*), **French contribution to space research.** *New York Academy of Sciences, Transactions*, Ser. 2, 22(8):674–679, June **1960. DLC**—An outline of French activity during the last century which has contributed directly and indirectly to the common progress in space research. *Subject Headings:* **1. Space science 2. Upper atmosphere research 3. France.**—*E.Z.S.* Ⓢ

11.12–464 551.507.362:629.19(023)

Gil'zin, Karl A., **Sputniks and after.** London, Macdonald, **1959.** 285 p. figs., 25 photos. Price 21 sh. "Translated by Pauline Rose from the original Russian; supplementary material translated by Dmitri Nesteroff; illus. by N. Kolchitsky." **DWB** (629.1388 G489sp)—A book written in popular style by a Russian scientist on the subject of space in the light of the recent Soviet achievements in this field. It tells of the foundations of astronautics, the principles of

this science, and its present and future. The discussion is divided into six chapters tracing the steady development of space science. The last chapters present interesting discussion of interplanetary travel and preparations for the flight of the first space ship. The book is extensively illustrated by graphs and photographs. *Subject Headings:* **1. Satellites 2. Astronautics. I. Rose, Pauline (transl.) II. Nesteroff, Dmitri (transl.) III. Kolchitsky, N. (illus.).**—*I.S.* Ⓢ

11.12–465 551.510.53:629.19

Newell, Homer E., Jr. (*NASA*), **The space environment.** *Science*, Wash., D. C., 131(3398):385–390, Feb. 12, **1960.** 6 figs. **DLC**—A discussion on what we already know about the space environment, and what man will encounter out in space. Accordingly, the discussion is organized into two parts. The first part considers the natural environment of the earth's outer atmosphere and space, and the second, the environmental conditions peculiar to flight through space. The paper is extensively and nicely illustrated by graphical representations, and photographs. *Subject Headings:* **1. Upper atmosphere 2. Space environment.** —*I.S.* Ⓢ

11.12–466 551.507.362

Trefall, Harald (*Fysisk Inst., Univ. Bergen*), **Litt om raketter og kunstige satellitter, Pt. 1. Raketter.** [Contribution on rockets and artificial satellites, Pt. 1, Rockets.] *Fra Fysikkens Verden*, Blindern, Norway, 21(1):193–207, July **1959.** 4 figs., table, 13 eqs. **Pt. 2, Kunstige jordsatellitter.** [Pt. 2, Artificial satellites.] *Ibid.*, 21(2):266–280, Dec. **1959.** 12 figs., table, 2 refs., 19 eqs. **DLC**—The first part gives a historic account of military rocketry, then the reaction principles, fuels, non-existent or rather light-time in space travel vs. time on earth are discussed. A dim view on manned space travel is based upon the collisional effect of particles on crew and ship plus the radiation hazards. The second part is devoted to a discussion of dynamics, orbits and braking of the satellites. The extreme delicacy of exactness and scientific teamwork of placing a satellite in orbit is explained. The calculated and observed lifetime of satellites differs less than 10%. The density variation in the outer atmosphere seems to be correlated with solar activity. *Subject Headings:* **1. Rockets 2. Satellites.**—*W.N.* Ⓢ

11.12–467 551.507.362:551.521.64

Kock, Winston E., (*Bendix Aviation Corp. Res. Lab., Detroit*), **Physics in the missile and satellite fields.** *Physics Today*, N. Y., 13(1):24–29, Jan. **1960.** 6 figs. **DWB** –Physics is playing an important role in the missile and satellite fields. The discovery of the great radiation belts by VAN ALLEN is a great step. Explorer and Vanguard satellites showed that earth is ½% less flat. Tremendous amounts of instruments are carried on satellites. Nuclear physicists play an important role in space efforts. Solid state physicists contribute through their work on computers. *Subject Headings:* **1. Satellite uses 2. Van Allen belts 3. Earth figure.**—*A.H.K.* Ⓢ

11.12–468 629.19 523.6:521.12

†Benedikt, E. T. (*Astro Systems and Research Lab., NORAIR*), **Scientific significance of deep space exploration.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 98–115. 4 figs., 33 refs., numerous eqs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—A (natural or artificial) planet moving under the action of the sun and the other members of the solar system will be acted upon, besides the Newtonian gravitational attraction of the above bodies, by a number of higher-order perturbations, such as relativity effects, various inertial forces arising from the rotation of the galaxy, possible inertial anisotropy effects, etc. The use of artificial comets with orbits selected in such a manner as to insure the greatest possible precision in the determination of their orbits, and such as to magnify the above effects is discussed. The great importance which astronautics might assume in the near future for the experimental investigations of fundamental scientific questions on a planetary scale is pointed out. *Subject Headings:* **1. Interplanetary travel 2. Artificial comets 3. Space exploration.**—*Author's abstract.* Ⓢ

11.12–469 551.510:533.6:629.13

Walter, William Chester (*Avro Aircraft Ltd., Canada*), **A quantitative analysis of the characteristics and limitations of aerodynamic flight within the atmosphere, Pt. 1, Characteristics.** *Aero Space Engineering*, N. Y., 18(8):43–46, 53, Aug. **1959.** 7 figs., 3 refs., 11 eqs. **Pt. 2, Limitations.** *Ibid.*, 18(9):63–66, Sept. **1959.** fig., 8–11. **DWB, DLC** —This paper presents the results of a quantitative analysis of the practical limits of aerodynamic flight within the atmosphere. The cruising vehicle flight regime and the aerospace vehicle flight regime are defined and analyzed. The fundamental equations relating to these limits are derived and analyzed. Design curves which should be of use in preliminary design and performance estimates are also presented. Although there is some overlap between the two flight regimes, each is seen to exhibit characteristics peculiar to the mode of operation which takes place within their respective limits. The analysis of the characteristics of the aerodynamic flight regime showed that centrifugal lift has a profound influence on the limitations of both cruising and aerospace vehicle flight, and that the effects of the variation of the Earth's gravitational acceleration are negligible in this area. *Subject Headings:* **1. Astronautics 2. Aerodynamic theories 3. Aeronautics.**—*I.S.* Ⓢ

11.12–470 551.501.9:551.507.362:37:79.071.22(788)

Stine, G. Harry (*Pres., Nat. Assoc. of Rocketry*), **Green Mountain Proving Ground: gateway to tomorrow.** *Space Journal*, Nashville, Tenn., 2(1):16–21, Sept. **1959.** 6 photos.—The article tells about Green Mountain Proving Ground, a missile testing area for the amateur rocketeers. It was founded in 1957 and is operating under the auspices of the Mile-High Section of the National Association of Rocketry. It is only 560 acres and is located within 10 miles of Denver, Colorado. It is equipped with all the essentials of a rocket testing area. This diminutive rocket proving ground is used to test diminutive missiles. The largest vehicle launched there to date was 36 in. long and weighed 1 lb. The average missile fired there weighs less than 2 ounces, is about 12 in. long, and reaches an altitude of 500 to 1000 ft. So far, over 10,000 model rockets have been flown there, and the safety record is perfect. There has not been a single accident. The article describes a typical day at Green Mountain and emphasizes the educational importance of such experience for the children who learn the rudiments of optics, meteorology, aerodynamics, electronics, thermodynamics and basic scientific disciplines—not from books, but from actual experience. Several photographs show the activities in the area. *Subject Headings:* **1. Education 2. Rocket development 3. Green Mountain Proving Ground, Denver, Colorado.**—*I.S.* Ⓢ

2. PROPULSION, POWER, GUIDANCE

11.12–471 551.507.362.1(08)

Baxter, A. D. (*Rocket Engine Div., de Havilland Engine Co. Ltd.*), **Some propulsion problems of high altitude rockets.** (In: Symposium on High Altitude and Satellite Rockets, Cranfield, England, July 1957, [**Proceedings**]. N. Y., Philosophical Library, 1959. p. 29–43. 14 figs., table, 11 refs., eq.) **DWB** (629.1388 S989hi)—Since thrust is the main problem in successful orbiting of a rocket, some selected items are considered in relation to improvement of the quantities of the standard rocket equation: $V = v \log e\ (M/m)$, where V = vehicle velocity at all-burnt, v = rocket engine jet velocity, M = weight of vehicle at take-off and m = weight of vehicle at all-burnt. The discussion concerns rocket performance, the propulsion system, engine performance and weight, rocket control and engine control. Some general conclusions are drawn and it is believed that better results are obtainable by using a number of engines <100,000 lbs thrust each rather than a single large one. *Subject Heading:* **1. Rocket propulsion.** —*W.N.* Ⓢ

11.12–472 538.69:539.17:629.1.02 551.507.362:525:523.43

Kunen, Alfred E. and McIlroy, W. (*both, Plasman Propulsion Lab., Republic Aviation Corp., Farmingdale, Long Island, N. Y.*), **The magnetic pinch engine for space flight.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 166–178. 11 figs. (incl. photos), 2 tables, 5 refs., eqs. **DWB** (629.1388

A512 pro), **DLC** (QB1.A26) –The electromagnetic pinch effect, familar to fusion research, may be adapted to accelerate ionized gas for space propulsion and satellite control. On discharging capacitors between two nozzle-shaped electrodes the current-carrying skin can be made to drive the gases axially outwards from the chamber. For a sufficiently high gas density the mechanism is treated as a solid "magnetic" piston driving a shock wave ahead of it into the gas. Different electrode designs were investigated experimentally and theoretically and the results compared. The results of an investigation into a one-way unmanned flight from an Earth orbit to a Mars orbit are presented. In addition the relationship between total weight/thrust and specific impulse, pulsing rate, weight of generating equipment, etc., was derived, and from these calculations conclusions were drawn regarding the optimum operating conditions for specific missions. *Subject Headings:* **1. Space ships 2. Interplanetary flights 3. Rocket propulsion.**—*Authors' abstract.* Ⓢ

11.12–473 551.507.362.1:539.17

Newgard, John J. and Levoy, Myron, **Nuclear rockets.** *Scientific American*, N. Y., 200(5):46–51, May **1959.** 7 figs. (incl. photo). **DWB, DLC**—Since chemical rockets are already approaching their theoretical limits, various ways of utilizing nuclear reactions for rocket propulsion have been suggested. Some of which are in the experimental stage. *Subject Headings:* **1. Nuclear rockets 2. Rocket propulsion.**—*N.N.* Ⓢ

11.12–474 551.507.362:621.499

Saltzer, C.; Craig, R. T. and Fetheroff, C. W., **Comparison of chemical and electric propulsion systems for interplanetary travel.** *Institute of Radio Engineers, N. Y., Proceedings*, 48(4):465–476, April **1960.** 9 figs., 7 refs., 82 eqs. **DLC**—The basic mission parameters which are required for the evaluation of engine performance for interplanetary flights are defined. The engine parameters are also defined, and the relation between these parameters is formulated. The possibility of achieving much larger payload fractions by the use of electric propulsion systems, as opposed to the use of chemical propulsion systems, is indicated. Methods of calculating impulsive orbit transfers between circular orbits, escape and entry from satellite orbits using low thrust, and optimized powered transfer between heliocentric orbits are given in the Appendix. *Subject Headings:* **1. Interplanetary flights 2. Rocket propulsion.** —*Authors' abstract.* Ⓢ

11.12–475 551.521.1:620.91:551.507.362.2

Sailor, J. Douglas (*Lockheed Missiles and Space Div., Palo Alto, Calif.*), **Solar photovoltaic power sources for space vehicles.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 149–156. 5 figs., table, 3 refs., 8 eqs. **DWB** (629.1388 A512 pro), **DLC** (QB1.A26)—The use of solar photovoltaic cells will provide satellites and space vehicles with a reliable source of electrical power. A nickel-cadmium secondary battery will be required to store power when the vehicle is in the earth's shadow or during peak loads. Earth satellites intercept minimum power when the earth-sun axis lies in the orbit plane. The efficiency of three typical configurations is derived. The cell area required by a space probe can be greatly reduced by erecting a solar "sail" behind the center of mass of the vehicle so that a plane solar array on the front of the vehicle would constantly face the sun. In order that the cell temperature be kept at a reasonable value (to maintain high cell efficiency), a protective coating is recommended. This coating must have good transmission in the visible region, high emissivity in the infrared, and must resist darkening due to the solar stream. It appears that micrometeorites, solar ultraviolet, and primary cosmic rays will have negligible effects on the solar cells for periods of several years. Protons in the trapped radiation belt, however, could seriously limit cell lifetime. A power-to-weight ratio of one watt per pound should be easily achieved by a solar power supply. *Subject Headings:* **1. Solar batteries 2. Space ship power supply.**—*Author's abstract.* Ⓢ

11.12–476 629.19:697

Breakwell, John V. (*Lockheed Missiles and Space Div., Palo Alto, Calif.*), **Fuel requirements for crude interplanetary guidance.** *American Astronautical Society, Proceedings, (Advances in the Astronautical Sciences)*, Vol. 5, 1959, issued **1960.** p. 53–65. 3 figs., numerous

eqs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—Trajectory accuracy is affected by (1) the accuracy with which position and/or velocity is measured, (2) the accuracy with which future position is computed, and (3) the accuracy with which corrective thrusts are instrumented. Some preliminary conclusions are reached concerning the optimum spacing of corrective thrusts and concerning the associated fuel requirements for typical trips. *Subject Headings:* **1. Astronautics 2. Rocket propulsion.**—*Author's abstract.* Ⓢ

11.12–477 629.19 551.507.362.2:521.312

Schütte, Karl, **Die ersten und zweiten Differentialquotienten in der elliptischen Bewegung als Funktionen des Geschwindigkeitsvektors.** [The first and second derivatives as functions of the velocity vector in elliptic motion.] *Astronautica Acta*, Vienna, 6(2/3):144–150, **1960.** 2 refs., 21 eqs. German, English and French summaries, p. 144. **DWB**—The trajectory of a space vehicle or artificial satellite is, in the two-body problem, fully determined by the velocity vector at any point of the trajectory. Any change of this velocity vector, for instance by additional propulsion or by perturbation from some other body, changes the osculating trajectory. Some simple formulae are derived for the first and second derivatives in terms of functions of the magnitude and direction of the velocity vector, for the trajectory elements, viz: major semi-axis, period, eccentricity and true anomaly. *Subject Headings:* **1. Astronautics 2. Satellite orbits.**—*Author's abstract.* Ⓢ

11.12–478 629.19:525.1:523.43

Kierstead, Friend H., Jr. (*Goodyear Aircraft Corp., Akron, Ohio*), **Guidance requirements for interplanetary flight.** *American Astronautical Society, New York, Adances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 66–81. 7 figs., 3 refs., 43 eqs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—The guidance requirements for lunar and interplanetary ballistic flights have been stated by MAGNESS and others in terms of error coefficients that relate the miss-distance at the target to the uncertainties in the initial velocity. However, for missions that include midcourse guidance, it is necessary to extend this approach to obtain coefficients that relate the midcourse position to the launch errors, and the miss-distance to the midcourse guidance uncertainties. Although these error coefficients can be obtained analytically from the equations of celestial mechanics, the expressions for the in-plane coefficients are quite cumbersome and unsuited to machine computation, especially for midcourse-to-terminal coefficients. It has been found more expeditious to obtain the coefficients from difference equations applied to a set of four machine-computed perturbed trajectories about each standard trajectory. The out-of-plane coefficient is easily obtained analytically. Numerical results are given for Earth-Mars flights using a two-dimensional, circular-orbit model for the solar system. *Subject Headings:* **1. Astronautics 2. Interplanetary flights 3. Rocket guidance.**—*Author's abstract.* Ⓢ

11.12–479 551.507.362.2:629.19

Mickelwait, Aubrey B.; Tompkins, Edwin H., Jr. and Park, Robert A., **Interplanetary navigation.** *Scientific American*, N. Y., 202(3):64–73, March **1960.** 16 figs. **DWB, DLC**—A discussion of the practical prospect of interplanetary flight in the light of recent satellite launchings. The next step in space flight will be for the rockets to bring the payload close to—or even land them upon—another planet. This requires difficult compromises among the conflicting demands of payload, radio communication, guidance and available power. This paper presents a systematic and extensively illustrated discussion of these problems of interplanetary navigation. *Subject Headings:* **1. Satellite launching 2. Interplanetary flights.** —*I.S.* Ⓢ

3. COMMUNICATION

11.12–480 551.507.362:621.398

Vogelman, Joseph H., **Propagation and communications problems in space.** *Institute of Radio Engineers, N. Y., Proceedings*, 48(4):567–569, April **1960.** 3 figs., 2 tables. **DLC**—The problems of propagation and communications arising from landings on the Moon, Venus, or Mars are treated in terms of the characteristics required for the communication system to achieve data transfer between parties on the surface of these bodies and the communications

problems arising in the transfer of information from these bodies back to the Earth. Consideration is given to Doppler shift, Faraday rotation, tracking and stabilization of antennas, and ground network requirements. The problems of communications between vehicles in space in terms of signal acquisition and antenna orientation and tracking are described. *Subject Heading:* **1. Interplanetary communication.**—*Author's abstract.* Ⓢ

11.12–481 551.507.362:523.43:621.396.8

Child, C. H. (*North American Aviation, Inc., Downey, Calif.*), **Requirements for data transmission from a Martian Reconnaissance Vehicle.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 261–277. 12 figs., table, 10 refs., 4 eqs. **DWB** (629.1388 A512 pro), **DLC** (QB1.A26)—An analysis is presented of the requirements for a communication system on a Solar System Reconnaissance Vehicle. The effects of various noise sources are evaluated in terms of their influence on operating frequencies. Transmitter power levels, receiver sensitivity, and noise figure properties are discussed in terms of present and projected developments. An operating frequency of approximately 850 Mc is recommended on the basis of maximum anticipated advances in the state of the art during the next 3 to 5 years. In terms of these advances, it appears that a transmitter power-supply weight of approximately 300 lb will be required to produce an rf power output of approximately 10 kw. Lesser degrees of advancement would cause the weight to increase to approximately 500 lb and the required power output to increase to approximately 60 kw. The problem of heat dissipation, based upon 50% conversion efficiency, is left to the airframe-structures and thermodynamics groups. *Subject Headings:* **1. Space ship power supply 2. Interplanetary communication.**—*Author's abstract.* Ⓢ

11.12–482 551.510.535:551.510.62:621.396.1

†Rix, H. D., **Radio propagation and ionized gases: a survey.** Pennsylvania. State Univ. Ionosphere Research Lab., Contract DA-36-061-ORD-577, Scientific Report, No. 123, Pt. A, Sept. 1, **1959.** 50 p. 2+3 figs., 4+11+49 refs., 22 eqs. **DWB** (M10.535 P415i)—This report surveys electromagnetic wave propagation effects relating to the problem of radio interference encountered during powered flight of large missiles. An expression for the absorption of a radio signal traversing a plasma is developed from the approximate theory of plasma conductivity. Results of more accurate treatments of conductivity theory are introduced by way of comparison. Equations showing the effect of a magnetic field on the signal are also given. Properties of several types of plasma—flames, gaseous discharges and shock waves—are described in terms of methods of measuring electron density, mechanisms of ionization and means of controlling free electron concentration. Specific propagation effects treated include high frequency antenna breakdown and ionospheric effects. A guide to the relevant literature of these various subjects is provided. *Subject Headings:* **1. Ionospheric radio wave propagation theories 2. Radio wave propagation through plasma 3. Radio communication with missiles.** —*Author's abstract.* Ⓢ

11.12–483 523.164.83

Blackband, W. T. (*Radio Dept., Roy. Aircraft Establishment, Farnborough, Hants.*), **Radio communication with a lunar probe.** *Royal Society of London, Proceedings, Ser. A*, 253(1275): 511–515, Dec. 29, **1959.** 3 figs., table, 2 refs., eqs. **DWB, DLC**—In the design of a communication system between the lunar probe and the earth the study of the radio noise is of importance. The paper treats the chief sources of radio noise, the variation of the noise with galactic coordinates and the variations of galactic noise with the frequency. A lunar probe might transmit 10 W at a distance of 400.000 km. The signal-to-noise ratio could be improved in three ways: 1) increasing the transmitted power, 2) using a larger receiving aerial, and 3) stabilizing the axes of the probe so that a directive transmitting aerial would be carried with its signal beamed toward the earth. *Subject Headings:* **1. Interplanetary communication 2. Lunar probes 3. Radio noise.**—*E.K.* Ⓢ

11.12–484 551.507.362:621.398

Diamond, Robert H., **Interplanetary telemetering.** *Institute of Radio Engineers, N. Y., Proceedings*, 48(4):679–685, April **1960.** 4 figs., table, 15 refs., 7 eqs. **DLC**—The use of

telemetry systems over interplanetary distances generates performance requirements more severe than even before experienced. Full exploitation of the foreseeable state-of-the-art and high over-all operational efficiencies will be essential in fulfilling the requirements of these rigorous standards of performance. The problem areas associated with interplanetary telemetry and an approach to the selection of system operating parameters are discussed. The analysis is based on the dividing of operational efficiency into two categories: information efficiency and physical system efficiency. The performance of a typical interplanetary system is analyzed to exemplify the importance of a number of the operating parameters which affect system performance. *Subject Headings:* **1. Telemetering systems 2. Interplanetary communication.**—*Author's abstract.* Ⓢ

11.12–485 551.507.362.2:621.398

Cherrick, I. L. (*ed.*) (*N. A. S. A. Headquarters Staff*), **Telemetry code and calibrations for Satellite 1959 Iota (Explorer VII).** *U. S. National Aeronautics and Space Administration, Technical Note*, D-484, May 1960. 48 p. 17 figs., 9 tables, 7 refs. **DWB, DLC**—This report is essentially limited to material necessary to decode and convert to basic measurements the data transmitted on the 19.992 Mc telemetry signal of Satellite 1959 Iota (Explorer VII). The interpretation of results is discussed only insofar as the individual experimenters have supplied comments in this regard. *Subject Headings:* **1. U. S. Satellite 1959 Iota (Explorer VII) 2. Radio satellite tracking.**—*Author's abstract.* Ⓢ

11.12–486 551.507.362:621.398

Williams, W. E., Jr., **Space telemetry systems.** *Institute of Radio Engineers, N. Y., Proceedings*, 48(4):685–690, April 1960. table, 14 refs. **DLC**—This paper presents some of the problems which are faced in the field of space telemetry, and gives a few examples of the approaches used in attempts to solve these problems to date. The different types of information to be transmitted back to receiving stations on the earth from satellites and space probes are discussed. The telemetry systems (FM/FM, FM/AM, PCM/PM, etc.) which have been used in various experiments of this type are described, along with some typical performance figures for some past payloads. The paper is concluded with a discussion of the problems to be faced in future experiments. *Subject Headings:* **1. Telemetering systems 2. Interplanetary communication.**—*Author's abstract.* Ⓢ

11.12–487 551.507.362:551.510.535:551.594.12:621.398

Dirsa, Edward F., **The telemetry and communication problem of re-entrant space vehicles.** *Institute of Radio Engineers, N. Y., Proceedings*, 48(4):703–713, April 1960. 8 figs., 41 refs., numerous eqs. **DLC**—The problems associated with propagation of electromagnetic telemetry and communication (and guidance) signals through the densely ionized region (plasma) generated by, and surrounding a hypersonic space vehicle re-entering the earth's atmosphere are reviewed. The nature and extent of the plasma-radio wave interference is explained in terms of the classical treatments which have evolved from ionospheric studies. The limitations of the simple classical models are pointed out in the light of the more complex nature of the hypersonically generated plasma. Methods for overcoming the deleterious influences of the plasma are presented, culminating in presentation of some new approaches to this problem. *Subject Headings:* **1. Telemetering systems 2. Interplanetary communication 3. Re-entry into atmosphere.**—*Author's abstract.* Ⓢ

11.12–488 551.507.362:621.398

Rochelle, R. W., **Signal-to-noise considerations for a space telemetry system.** *Institute of Radio Engineers, N. Y., Proceedings*, 48(4):691–693, April 1960. 2 figs. (incl. photo), 2 refs., 3 eqs. **DLC**—A signal-to-noise comparison is given between the pulse-frequency channels and the pulse-width channels for the FM/PDM-AM telemetry system. It is shown that the pulse-frequency channels have either a higher signal-to-noise ratio or greater information rate capability than the pulse-width channels. *Subject Headings:* **1. Telemetering systems 2. Interplanetary communication.**—*Author's abstract.* Ⓢ

11.12–489 523.4:621.397.9

Viterbi, A. J. (*Jet Propulsion Lab., Calif. Inst. of Technology, Pasadena*, **Design techniques for space television.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 291–305. 7 figs., 3 refs., 40 eqs. **DWB** (629.1388 A512 pro), **DLC** (QB1.A26)—The basis for establishing a television system for obtaining visual images of the planets is outlined. This entails consideration of the distances involved, signal levels and noise environment. An FM-PM communication system is described and design restrictions formulated. The problem is then illustrated by an example involving transmission of a television image from the vicinity of Venus. *Subject Headings:* **1. Interplanetary communication 2. Space television.**—*Author's abstract.* Ⓢ

11.12–490 551.507.362.2:621.396.4

Vilbig, Friedrich (*Communication Sciences Lab., Air Force Cambridge Research Center*), **Global communication using passive or active satellite relay stations.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 251–260. 9 figs., 2 refs., 12 eqs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—The limitations of present-day long-distance communication links are compared with the limitations of links which might use passive or active satellite relay stations. The paper is largely concerned with orbital paths and the number and distribution of satellites required for several possible communication systems. A probability calculation showing the distribution and number of satellites required for line-of-sight interception at any earth point is also given. *Subject Heading:* **1. Communication satellites.**—*Author's abstract.* Ⓢ

11.12–491 523.164.42:523.854

Bracewell, R. N. (*Radioscience Lab., Stanford Univ.*), **Communications from superior galactic communities.** *Nature*, London, 186(4726):670–671, May 28, **1960.** fig., 6 refs. **DWB**—Drake (1959) has described equipment under construction to look for transmissions from advanced societies elsewhere in the Galaxy. He plans to look at Ceti and Eridani. It seems more reasonable that we look for probes sent here, and we in turn send probes. The important thing for us is to be alert to the possible interstellar origin of unexpected signals and be prepared to communicate with the sender. *Subject Headings:* **1. Radio emissions from galaxy 2. Intergalactic communication.**—*E.Z.S.* Ⓢ

11.12–492 523.164.42:551.521.18

Dyson, Freeman J. (*Inst. Adv. Study, Princeton, N. J.*), **Search for artificial stellar sources of infrared radiation.** *Science*, Wash., D. C., 131(3414):1667–1668, June **1960.** 3 refs. **DLC**—If extraterrestrial intelligent beings exist and have reached a high level of technical development, one by-product of their energy metabolism is likely to be the large-scale conversion of starlight into far-infrared radiation. It is proposed that a search for sources of infrared radiation should accompany the recently initiated search for interstellar radio communications. *Subject Headings:* **1. Infrared radiation 2. Interstellar communication.**—*Author's abstract.* Ⓢ

4. RE-ENTRY PROBLEMS

See also: **Communication problem of re-entrant space vehicles** (Dirsa), 11.12–487.

11.12–493 629.19:531.56:613.693

Gazley, Carl, Jr. (*Aero-Astronautics Dept., RAND*), **Atmospheric entry of manned vehicles.** *Aero/Space Engineering*, N. Y., 19(5):22–23, 90, May **1960.** 2 figs., 2 refs. Port., vita p. 22. **DLC**—The requirements of atmospheric entry of manned vehicles are analyzed. Based on the dynamics of a vehicle's motion during atmospheric entry the initial velocity and path angle as well as the body's aerodynamic lift and drag characteristics and its mass-area ratio have to be taken into consideration. The type of surface protection or cooling system are determined by the rate-reduction of the vehicle's kinetic energy and by the fraction of that energy reaching the vehicle as heat. The weight is a prime consideration in selection from a variety of surface protection cooling systems. A blunt dense vehicle with little or no

aerodynamic lift and a low temperature ablation-cooling system, and a radiation-cooled vehicle using a very light drag brake or lifting surface are examined as possible types of vehicles for manned entry. Diagrams of maximum heating rate and total heat load during entry and of cooling-system weight requirements illustrate the study. *Subject Headings:* **1. Re-entry into atmosphere 2. Interplanetary flights 3. Space medicine.**—*O.T.* Ⓢ

11.12–494 551.507.362:521.312:531.56

Gedeon, Geza S. (*Chance Vought Aircraft, Inc., Dallas, Texas*), **An analytical method for determining the orbital characteristics of a nonlifting body which passes through the lower atmosphere of a planet.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 325–337. 8 figs., 3 refs., 27 eqs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—An analytical method is presented for calculating the characteristics of rapidly decaying eccentric orbits (braking ellipses). The solution reveals the important parameters which govern the decay and thus simplifies the "feasibility studies" of reentry. The differential equations which describe the motion of a body in the atmosphere of a planet are strongly cross-coupled. Eliminating, however, the time variable through the moment of momentum, the cross coupling is so much weakened that a good approximate solution can be obtained for eccentric orbits by integrating alternately the equations per half turn. The inherent error in the approximation was found to be small and independent of the initial conditions until the greater part of the orbit is about 70 miles. Thus, with a constant correction factor, which is obtained from stepwise numerical integration, the apsides and their positions can be predicted within the error made, e.g., by neglecting the oblateness of the earth. *Subject Heading:* **1. Re-entry into atmosphere.**—*Author's abstract.* Ⓢ

11.12–495 551.507.362.2:521.31

Grant, Frederick C. (*Langley Research Center, Langley Field, Va.*), **Analysis of low-acceleration lifting entry from escape speed.** *U. S. National Aeronautics and Space Administration, Technical Note*, D-249, June **1960.** 21 p. 6 figs., 5 refs., 23 eqs. **DWB, DLC**—An earlier analysis of lifting satellite entry for circular orbit velocities is extended to the case of parabolic orbit velocities. Simple formulas are derived which yield approximations to the minimum loadings for steep entries. The general advantage of operation on the high-drag side of maximum lift-drag ratio is demonstrated analytically. The optimum character of modulation from maximum lift coefficient is shown. A principal parameter is shown to be the ratio of maximum lift coefficient to minimum drag coefficient. The analytical results are compared with those of detailed numerical integrations for an entry vehicle with a simplified but realistic lift polar. *Subject Heading:* **1. Satellite re-entry.**—*Author's abstract.* Ⓢ

11.12–496 551.507.362.521.312:531.56

Harris, I. and Jastrow, R. (*both, Nucleonics Div. U. S. Naval Res. Lab., Wash., D. C.*), **Re-entry of the Sputnik I rocket.** *Planetary and Space Science*, N. Y., London, 1(1):37–39, Jan. **1959.** 3 figs., 3 refs. **DLC**—The problem of the final stage of re-entry of artificial satellites into the atmosphere is discussed in the light of the data on Sputnik I. The details of the re-entry analysis, based on several observations of the altitude of the satellite during the last 5 days of its life time, are discussed and graphically represented. The data leads to the conclusion that this satellite fell on Dec. 1 at 0846 GMT. The graphically represented trajectory of 1957 Alpha I during its final pass over the northern hemisphere shows the probable point of impact at latitude 45°N and longitude 106°E, in Outer Mongolia. *Subject Headings:* **1. Soviet satellite 1957 Alpha I (Sputnik I) 2. Re-entry into atmosphere.**—*I.S.* Ⓢ

11.12–497 551.507.362.2:521.312:531.56

Hilton, W. F., **Recovery after re-entry, by the use of aerodynamic lift.** (In: Symposium on High Altitude and Satellite Rockets, Cranfield, England, July 1957, [**Proceedings**]. N. Y., Philosophical Library, **1959.** p. 58–71. 6 figs., 5 tables, 3 refs., 8 eqs.) Appendix: Hammett, D.: **Re-entry of a spherical vehicle.** p. 66. **DWB** (629.1388 S989hi)—A radically new solution is proposed to the problem of re-entry into the earth's atmosphere by the use of aerodynamic lift. A non-dimensional number is tabulated, which should govern the lift/weight

ratio to be achieved at various flight speeds by all re-entry vehicles. At speeds above the escape velocity 7 miles/sec, this lift must be directed towards the earth in order to maintain contact with the atmosphere. At speeds below satellite speed of 5 miles/sec., the lift must be directed away from the earth to sustain the weight and minimize heat input. The range 5 miles/sec to 7 miles/sec, permits elliptical orbits and vehicle altitude in the atmosphere is unimportant. The suggested design of vehicle produces maximum drag associated with maximum lift and is thus unlike conventional designs. At the same time, the pilot, radio mast and escape hatch are protected from extreme heating effects by being placed in an aerodynamic vacuum. The vehicle always flies near to maximum lift, at an incidence of $30° \pm 10°$. Altitude is controlled by a rolling maneuver to $\pm 50{,}000$ ft. Spin stabilization is suggested, but is not essential. *Subject Headings:* **1. Recovery of space vehicles 2. Re-entry into atmosphere.**—*Author's abstract.* Ⓢ

11.12–498 551.507.362:521.312:531.56

Loh, W. H. T. (*Chance Vought Aircraft*), **Dynamics and thermodynamics of re-entry.** *Journal of the Aerospace Sciences*, N. Y., 27(10):748–762, Oct. **1960.** 12 figs., 15 refs., 59 eqs. **DLC**—This paper presents a summary of the approximate analytical solutions on velocity, altitude, range deceleration, maximum deceleration, time rate and maximum time rate of average and local stagnation region heat transferred into vehicle, total heat transferred into vehicle, and time of flight for boost glide or orbital re-entry into planetary atmosphere for various kinds of re-entry trajectories. These trajectories include 1) great circle flight at small angles of inclination, 2) great circle flight at large angles of inclination, 3) minor circle flight at small angles of inclination, 4) minor circle flight at large angles of inclination, 5) constant equilibrium temp. flight, 6) constant deceleration flight, 7) constant aerodynamic load factor flight, 8) constant rate of descent flight, 9) constant angle of inclination flight, and 10) constant rate of heat input flight. *Subject Headings:* **1. Re-entry into atmosphere 2. Astronautics.**—*Author's abstract.* Ⓢ

11.12–499 551.524.7:551.507.362.2

Murray, P. (*U. K. Atomic Energy Res. Group, Harwell*), **High temperature materials in relation to the satellite re-entry problem.** (In: Symposium on High Altitude and Satellite Rockets, Cranfield, England, July 1957, [**Proceedings**]. N. Y., Philosophical Library, **1959.** p. 82–88. 4 tables, 5 refs.) **DWB** (629.1388 S989hi)—The effect of the extreme conditions of re-entry on the problem of the choice of constructional materials is discussed; it is considered necessary that the shell must be metallic and protection of the alloys used as the base material is essential. It is doubtful if protective coatings alone would withstand the erosion/abrasion conditions. Massive insulation has the advantage of protection together with that of reducing the metal surface temperature to reasonable levels and hence allowing the possible use of light alloys. Possible ways of fixing the insulation to the metal surface are also discussed. *Subject Headings:* **1. Satellite re-entry into the atmosphere 2. High temperature effects on satellites 3. Heat resisting construction materials.**—*Author's abstract.* Ⓢ

11.12–500 551.507.362-551.510.5:531.56

Stalony-Dobrzanski, J. (*Advanced Planning Staff, Systems Develop. Lab., Hughes Aircraft Co., Culver City, Calif.*), **Effect of reentry technique on the design of a space vehicle.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 237–247. 8 figs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—The vehicle considered is a piloted lifting vehicle of airplane-like configuration capable of normal landing. The major variable affecting the design is the re-entry angle. With a design primarily radiation-cooled there is a tendency toward the use of very small angles of re-entry which, on the other hand, lead to excessive ranges and extreme difficulty in maintaining an accurate navigation. Thus a strong conflict exists between the vehicle design and navigation-system requirements. The paper shows that there is a rather limited range of entry angles where a useful compromise between these opposing requirements can be obtained by departing slightly from a purely radiation-cooled design. For a small weight penalty of a few percent of the re-entry weight an order of magnitude improvement in the accuracy of navigation is possible. *Subject Headings:* **1. Space ships 2. Re-entry into atmosphere.**—*Author's abstract.* Ⓢ

11.12–501 551.507.362:551.510.5:531.56

Swenson, Byron L. (*Ames Research Center, Moffett Field, Calif.*), **A study of methods for simulating the atmosphere entry of vehicles with small-scale models.** *U. S. National Aeronautics and Space Administration, Technical Note,* D-90, April **1960.** 51 p. 11 figs., 8 refs. numerous eqs. **DWB, DLC**—An analysis is presented for the motion and aerodynamic heating of both glide and ballistic vehicles during atmosphere entry. Approximate trajectories are developed and it is shown that a generalized heating-rate history is possible for different types of vehicles and trajectories. Simulation of the effects of heating on various heat shielding designs is considered. Similarity relations for the investigation of full-scale vehicles by testing small-scale models are developed. *Subject Headings:* **1. Space ships 2. Re-entry into atmosphere.**—*Author's abstract.* Ⓢ

5. HUMAN FACTORS

11.12–502 613.693:629.19

de Callies, Richard N. (*Head, Aircraft Systems Section, Air Branch, Off. of Naval Research, Washington, D. C.*), **Human factors in spacecraft technology.** *American Astronautical Society, New York, Advances in the Astronautical Sciences,* Vol. 5, 1959, issued **1960.** p. 39–50. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—The reliability of the man—machine system can be no greater than the reliability of the weakest link. The job of the human-factors specialist is to insure that the weakest link is not the man. Man is tied to the system and maximum efficiency is achieved by meeting environmental and functional requirements of man and machine. Man has had to select and combine information inputs (displays) in order to effect information outputs (controls) based on decision time. Decision time is a function of basic response time, generally not alterable, and perceptual judgment time which can be reduced by supplying information in a form requiring less mental processing. Since 1953, the Office of Naval Research has been actively engaged in a program which reduces the perceptual judgment time of pilots of high-performance aircraft. It has been determined that only two basic instruments are needed to provide information to the pilot in lieu of the many dials and indicators formerly utilized. The methodology and techniques developed in this program are directly applicable to the achievement of maximum effectiveness in the operation of space vehicles. A program for establishing the informational requirements of space flight is discussed. *Subject Headings:* **1. Astronautics 2. Space medicine.**—*Author's abstract.* Ⓢ

11.12–503 629.19:613.693

†Imus, Henry A. (*U. S. Naval School of Aviation Medicine, Pensacola, Fla.*), **Human factors in probing outer space.** *American Astronautical Society, New York, Advances in the Astronautical Sciences,* Vol. 5, 1959, issued **1960.** p. 15–24. fig., 3 tables, 50 refs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—Although the U. S. Government is now committed to the conquest of outer space, some scientists question seriously the necessity for a human passenger. They contend that electronics engineering can provide automatic data-collecting and transmitting devices. If it becomes essential to send man into outer space in order to make scientific observations, the selected scientists and astronauts must be provided with a terrestrially equivalent space cabin, the environment of which will enable them not merely to survive, but to function efficiently, both mentally and physically. They must be provided, also, with tools and equipment adequate for the accomplishment of their mission. The mission of man in space must be defined clearly and limited strictly to carefully determined, essential scientific investigations which cannot be accomplished without the physical presence of the human investigator. Otherwise, unrealistic research and development will waste fantastic sums of money and scientific talent. The unique requirements for space travel necessitate complete physical protections and physiological support for the space travelers. Psychological factors such as stability, judgment under pressure, and competency to deal with hazardous emergencies must be considered along with the physical and physiological stresses. Arrangements must be made to combat the boredom, fatigue, and isolation which contribute to loss of efficiency. Not only in the space vehicle, but also in the ground control stations, man must be considered as an engineering component of the total systems involved. The process of "quickening" must be engineered into these systems so that the tasks of the astronauts and the ground crews are changed from those of complex anticipation to those of simple target following. Extreme

care and foresight are essential in programming every moment and hour of space flight. *Subject Headings:* **1. Astronautics 2. Space medicine.**—*Author's abstract.* Ⓢ

11.12–504 551.507.362.2:612

Gerathewohl, Siegfried J. and Steinkamp, George R. (*both, School of Aviation Medicine, USAF, Randolph Air Force Base, Texas*), **Human-factors requirements for putting a man in orbit.** *Astronautica Acta*, Vienna, 5(1):73-84, **1959.** 3 tables, 16 refs. English, German and French summaries, p. 73. **DWB**—Man's survival and operational capability in an artificial earth satellite depend primarily on the reliability and accuracy of the launching, guidance and recovery operations on the one hand, and on the perfection of his engineered environment, on the other. Although the human organism is much more sensitive and vulnerable than that of many other creatures, his greater versatility and higher intelligence assure his survival under new and threatening circumstances. If a physiologically habitable environment is created, and if its functions during orbiting are secured, the human passenger can withstand the stresses involved in manned satellite operations of a limited duration. *Subject Headings:* **1. Manned satellites 2. Environmental physiology 3. Human survival in satellites.**—*Authors' abstract.* Ⓢ

11.12–505 551.507.362.2:613.693

Henry, J. P. (*U. S. A. F. Air Res. & Dev. Command, Brussels, Belgium*), **Psychophysiological hazards of satellite flight.** (In: Symposium on High Altitude and Satellite Rockets, Cranfield, England, July 1957, [**Proceedings**]. N. Y., Philosophical Library, **1959.** p. 107–114. 2 figs., 17 refs.) **DWB** (629.1388 S989hi)—Previous work with animals in rockets and in a sealed environment showed that the disturbance in sensory input may lead to abnormal behavior. Human and animal experiments by Hebb and others, which were specifically aimed at studying the effects of decreased variation in sensory inflow into the brain, have demonstrated the psycho-physiological hazard imposed by a severe reduction in sensory input. The nature of the mental breakdown that follows severe sensory deprivation is being actively studied. The symptoms of sensory deprivation are discussed briefly in the light of recent psycho-physiological research results and the importance of making further studies in this area is stressed. These observations imply that the human operator's task should be designed to avoid prolonged periods of exposure to an environment in which he can perceive nothing that he regards as significant. *Subject Heading:* **1. Space medicine.**—*Author's abstract.* Ⓢ

11.12–506 613.693:629.19

Kuehnegger, Walter (*Martin Co., Denver*), **The reaction control simulators: a flight trainer for manned orbital and space vehicles.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 33–38. 5 figs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—This paper explains the need for, and presents a more complete reaction control device to qualify and prepare personnel for orbital and space flight. The paper covers design of the basic unit, control system, communications, safety provisions, and suggests various uses and applications. *Subject Headings:* **1. Astronautics 2. Space medicine.**—*Author's abstract.* Ⓢ

11.12–507 551.507.362:551.510.53:531.56

Sommer, Simon C. and Tobak, Murray (*both, Ames Research Center, Moffett Field, Calif.*), **Study of the oscillatory motion of manned vehicles.** *U. S. National Aeronautics and Space Administration, NASA Memorandum*, 3-2-59A, April **1959.** 30 p. 8 figs., 5 refs., 38 eqs. **DWB** (629.1388 U584me)—An analysis is made of the oscillatory motion of vehicles which traverse arbitrarily prescribed trajectories through the atmosphere. Expressions for the oscillatory motion are derived as continuous functions of the properties of the trajectory. Results are applied to a study of the oscillatory behavior of re-entry vehicles which have decelerations that remain within limits of human tolerance. It is found that a deficiency of aerodynamic damping for such vehicles may have more serious consequences than it does for comparable ballistic missiles. *Subject Headings:* **1. Re-entry of manned vehicles 2. Space vehicle oscillations.**—*Authors' abstract.* Ⓢ

11.12–508 629.19:613.693

Rabbit and two dogs recovered from space. *Science*, Wash., D. C., 130(3370):258, July 31, 1959. fig. **DLC**—A payload of more than 4400 lbs including the weight of the animals, the heaviest yet put into space was launched in the Soviet Union on July 2, 1959 and returned in good condition. The instruments aboard the missile sent back information on the animals' reaction to weightlessness, on the ultraviolet part of the solar spectrum, on the structure of the ionosphere, and on the direction and speed of air streams at various altitudes. *Subject Headings:* **1. Astronautics 2. Space medicine.**—*E.Z.S.* Ⓢ

6. SPACE ROCKETS

See also: **Preliminary results from space probe Pioneer V** (Fan et al.), 11.12–99; **Exploring depth of surface layer of the Moon from radar space observatory** (Fensler et al.), 11.12–180; **Soviet Moon rockets**, 11.12–181 to 11.12–186; **Radial rocket survey of geomagnetic field** (Sonett et al.), 11.12–296; **Interplanetary magnetic field** (Coleman), 11.12–315; **Magnetic field of the Earth** (Dolginov, Pushkov), 11.12–316; **Extraterrestrial current system** (Smith et al.), 11.12–317.

11.12–509 629.19:523.4

Voyages interplanétaires. [Interplanetary travels.] *Ciel et Terre*, Brussels, 75(7/8):246–250, July/August 1959. **DLC**—A brief review is presented of the elementary notions relating to distance and dimensions of the principal planets and the nearest stars. Speculation is made on the feasibility of bringing satellites into the orbit of planets and on the possibility of reaching the planets; including the required speed and the distance to be covered. The author gives some physical data relating to the atmosphere of planets and some philosophical considerations on interplanetary travel. *Subject Headings:* **1. Astronautics 2. Planetary atmospheres 3. Interplanetary travel.**—*A.V.* Ⓢ

11.12–510 551.507.362.1:551.521.64/.67

Kukarkin, B. V., **Zapusk kosmicheskikh raket i astronomicheskie problemy.** [The launching of rockets into outer space and some astronomical problems.] *Priroda*, Moscow, 3:7–8, March 1959. **DLC**—The launching of the first interplanetary cosmic rocket on Jan. 2, 1959 which reached the 2nd cosmic speed of 11.2 km/sec is of exceptional importance for the development of astronomy. It will become possible to study the cosmic rays in the state in which they are propagated in the interstellar space. The same applies to corpuscular radiation of the Sun and to interplanetary and interstellar gas. The attainment of the 3rd cosmic velocity and of the interstellar space, the next stages of rocket technique, is now conceivable. *Subject Headings:* **1. Rocket launching 2. Interplanetary flights 3. Corpuscular radiation.**—*A.M.P.* Ⓢ

11.12–511 551.507.362.1:629.19

Ross, Robert E. (*Operations Research, General Dynamics Corp., Electric Boat Div., Groton, Conn.*), **Dynamic response surfaces for nonlinear equations of rocket-powered flight.** *Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 116–137. 18 figs., 7 refs., 32 eqs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—The existence of several complementary analytic methods of solution, geometric as well as algebraic in nature, is demonstrated in the case of the set of first-order, nonlinear equations of powered flight. The techniques offered in this paper may be employed to achieve an optimal choice of boost-rocket configuration and have been classified in two ways: 1) evolution of practical criteria, and 2) differential operator development. Attention is focused primarily upon the representation of three parametric sets comprising the multivariate, nonlinear functions. To do so effectively, a series of isometric graphs are constructed. One involves terminal acceleration of the vehicle. A second isometric depicts a probably error surface, the derivation of which is both instructive and general. The third, multidimensional surface represents variations in terminal velocity with mass ratio, specific impulse, and cruise altitude. An additional possible mode of optimization is likewise shown with the superposition of two curvilinear surfaces, one for optimal Mach number, the other for maximum altitude at burnout. Thus, it is readily seen that minimal weight of boost rocket alone need not be the principal

parameter of choice, but a trade-off between several parameters is both desirable and expedient. Resolution of parametric decisions is appreciably enhanced by exact, visual methods, sufficiently well founded on the basic concepts of mathematical analysis. The techniques shown in this discourse are applicable to nonlinear equations of higher order. *Subject Headings:* **1. Rocket flights 2. Astronautics.**—*Author's abstract.* Ⓢ

11.12–512 551.507.362:629.19

Nicks, O. W. (*Chance Vought Aircraft, Inc., Astronautics Div., Dallas, Texas*), **A systematic approach to a matrix of space research vehicles.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 206–217. 9 figs., 19 refs., 8 eqs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—This paper deals with the problem of performing research experiments in space, and specifically with a way of providing the basic scientist or engineer with a simple, reliable research booster vehicle. Emphasis is placed on the development of a family of boost vehicles designed to carry research payloads on altitude sounding flights, dynamic re-entry missions, earth orbital missions, and lunar and planetary probe missions. Basic considerations are that many research payloads weighing 500 lb or less are required for space experiments, and further that the scientific personnel responsible for these experiments need a simple, reliable vehicle to serve as a tool for placing payloads on the proper missions. A theoretical analysis is presented which brings to light the basic parameters of concern to such vehicles, and points the way to an efficient building block approach. The philosophy for guidance and control commensurate with the building block vehicle concept is also briefly reviewed. The results of the analysis lead to a program of adapting existing components into an actual vehicle family. The major considerations for the family are discussed, including a summary of the vehicle capabilities and applications. Solid rockets are considered for vehicle control as well as primary propulsion in the interest of simplicity and maximum reliability for the research applications. *Subject Headings:* **1. Space ships 2. Astronautics.**—*Author's abstract.* Ⓢ

11.12–513 551.507.362:683.96:536.33

Cornog, Robert (*Ramo-Wooldridge Div. of Thompson Ramo Wooldridge, Inc., Inglewood, Calif.*), **Design optimization of thermal radiators for space vehicles.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 141–148. fig., 2 tables, 13 eqs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—Except during transient operation, the heat rejected by a space-borne heat engine can be dissipated only by means of thermal radiation. Since the weight of these necessary radiators is often a major component of the total weight of the heat engine, it is important that such radiators be designed to have minimum weight. One possible approach to the design of minimum-weight radiators is discussed in this paper. It is found that in designs in which the heat is radiated from extended area surfaces thermally connected to pipes carrying the fluid being cooled, for minimum weight, the radiating surface should be constructed of material having high thermal conductivity and low density. Likewise the fluid-carrying pipes should be of small diameter and closely spaced. It is also found that the weight of the plumbing used to connect the radiating surface to the heat source may be the major component of the total weight of the radiator installation. *Subject Headings:* **1. Space ships 2. Rocket engines.**—*Author's abstract.* Ⓢ

11.12–514 551.507.362:521.312

Swanson, Robert S. (*Consultant Astronautics*) and Petersen, Norman (*Chief, Astro Systems and Research Group, NORAIR*), **The influence of launch conditions on the friendly rendezvous of astrovehicles.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 218–236. 1 fig., 6 tables, 10 refs., 4 eqs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—The methods of determining "rendezvous-compatible orbits" are presented, with emphasis on the special rendezvous-compatible orbits that allow two rendezvous per Earth's rotation (corrected for the precession of the nodes caused by the Earth's oblateness) from a single launch base. The effects of launch-base latitude on the elements of the rendezvous-compatible orbits are discussed. Tables of the lower-altitude orbits for satellites launched from the Atlantic Missile Range and from equatorial launch bases are presented. The small but important effect of the actual injection point being down-

range about 900 NM from the launch base is considered, and the appropriate rendezvous-compatible orbits are presented. The formulas suggested by L. BLITZER for the regression of the nodes and the nodal period caused by the earth's oblateness are used. Correlation of actual satellite data with the satellite-oblateness theory will be required before actual rendezvous-compatible orbits are established. The values presented herein give the important features of these orbits and the method of determination. *Subject Headings:* **1. Satellite rendezvous 2. Rocket launching.**—*Authors' abstract.* Ⓢ

11.12–515 629.19:525.1:523.43

Johnson, Paul G. and Smith, Roger L. (*both, Lewis Research Center, National Aeronautics and Space Administration, Cleveland, Ohio*), **Round-trip trajectories for Mars observation.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, 1959, issued **1960.** p. 181–205. 20 figs., table, 5 refs., 10 eqs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26) –The characteristics of Earth-Mars round-trip ballistic trajectories are compared in terms of (1) total velocity increment, (2) total trip time, (3) choice of launch date and waiting time, (4) communication distance, and (5) sensitivity to departure-velocity-vector error. Particular emphasis is given short-waiting-time paths. Two families are shown to be of primary interest: (a) low-waiting orbiting paths, and (b) perihelion swing-around paths. The analysis is based on the assumption of circular, coplanar planetary orbits. *Subject Headings:* **1. Interplanetary flights 2. Mars.** –*Authors' abstract.* Ⓢ

11.12–516 551.510.53:629.19

Hoeppner, Conrad H. (*Radiation Inc., Melbourne, Fla.*), **Space electronics.** *Institute of Radio Engineers, N. Y., Proceedings*, 48(4):435–437, April **1960. DLC**—This introductory section consists of some preliminary remarks on "space electronics," the subject of this issue, and a brief outline of the contents thereof. A systematic discussion is presented of the aims and objectives of space exploration, of current plans and projects in the field, and of the future problems. The contents of this issue are described as consisting of papers on electronic propulsion, methods of navigation and guidance for interplanetary travel, the use of satellites for navigation of ships, planes and other vehicles on the earth's surface, space communication, tracking and surveillance and telemetry. *Subject Headings:* **1. Space electronics 2. Astronautics.**—*I.S.* Ⓢ

11.12–517 551.507.362.1:52

Friedman, Herbert (*U. S. Naval Res. Lab., Wash., D. C.*), **Rocket astronomy—window into space.** *Astronautics*, N. Y., 4(1):26–27, 69–70, Jan. **1959.** figs., port, vita. **DLC** –During the last 25 years great progress has been made in astronomy due to the use of cosmic radio waves. The introduction of rockets is going to develop this science still more. In June 1958, the American Astronomical Society described the first successful efforts to take a new look at the universe by means of rocket astronomy. The technique is illustrated through a figure. It is a well known fact that a large amount of matter in the universe is in the shape of dust and gases. This is a great hindrance in the study of the universe. Soon this problem will be solved by the use of large telescopes mounted on rockets with a payload of 1000 lbs. *Subject Headings:* **1. Rocket astronomy 2. Progress in astronomy.**—*A.H.K.* Ⓢ

11.12–518 523.7 551.507.362.2

Muller, P. (*Observatoire de Meudon*), **Evasions, planètes artificielles et tirs solaires.** [Escapes, artificial planets and solar shots.] *L'Astronomie*, Paris, 73(1):17–20, Jan. **1959. DLC** —This article shows that it is easier to leave definitively the Sun and its system than to reach the Sun itself. For this purpose, the author recalls and defines the following notions: speed of escape or of releasing, "parabolic speed" and velocity on impact. It is established that the minimum initial velocity in order to send an object to the Sun is 29.04 km/s. *Subject Headings:* **1. Solar system 2. Artificial planets 3. Solar probes.**—*A.V.* Ⓢ

11.12–519 551.507.362.1:523.7

Haviland, R. P. (*Missile and Ordnance Systems Dept., G. E. Co., Philadelphia*), **Considerations of the solar probe.** *International Astronautical Congress, Amsterdam, Aug. 1958, Proceed-*

ings of the 9th Congress, Vol. 1:44–53, issued **1959.** 7 figs., table, 6 refs., 8 eqs. English, German and French summaries. **DLC** (TL787.I44)—A solar probe to investigate the solar atmosphere is considered with respect to propulsion, thermal design, component temperature limits, attitude stabilization and telemetry. A selected set of probe experiments are reviewed, and a suitable probe shown schematically. It is concluded that the present state of the rocket art limits the distance of closest approach to the Sun to the orbit of Mercury, but that available probe components would permit design of a probe capable of reaching within 5 million miles of the solar surface. *Subject Headings:* **1. Rockets 2. Solar probes.** —*Author's abstract.* Ⓢ

11.12–520 551.507.326.1:551.510.536:523.35

Singer, S. Fred (*Physics Dept. Maryland Univ.*), **Scientific problems in cislunar space and their exploration with rocket vehicles.** *Astronautica Acta*, Vienna, 5(2):116–125, **1959.** 3 figs., 9 refs. English, German and French summaries p. 116. **DWB.** Also issued as: *International Astronautical Congress, Amsterdam, Aug.* 1958, *Proceedings of the 9th Congress*, Vol. 2:904–913, issued **1959. DLC**—The paper discusses scientific measurements which can be carried out in the "cislunar" region between the Earth and the Moon. Stress is placed on such problems as the space distribution and intensity of cosmic rays, auroral particles, and other corpuscular radiations some of which might be responsible for the magnetic storm producing ring current. The Moon's magnetic field is discussed, as well as measurements of the lunar atmosphere and lunar tidal bulge. *Subject Headings:* **1. Rocket exploration of the upper atmosphere 2. Outer atmosphere investigations 3. Moon.**—*Author's abstract.* Ⓢ

11.12–521 551.501.721:551.507.362.1:551.521.64

Josias, Conrad (*Met. Propulsion Lab., Calif. Inst. of Tech., Pasadena*), **Pioneer's radiation-detection instrument.** *Astronautics*, N. Y., 4(7):32–33, 114–115, July **1959.** figs. (incl. photos), port. and, vita. **DLC**—One of the principal aims of the Juno II rocket, launched on 3 March, 1959 from Cape Canaveral, was to measure radiation intensity along a nominal trajectory between the Earth and the Moon. Two Geiger-Mueller tubes were used for radiation detection. The whole system, which was designed by J. Van Allen, is shown in the figures. The results obtained by this experiment are now history. *Subject Headings:* **1. Rocket radiation data 2. Radiation intensity measurement techniques 3. Van Allen belts.**—*A.H.K.* Ⓢ

11.12–522 551.507.362:551.521.64

Van Allen, James A. and Frank, Louis A., **Radiation measurements to 658,300 km. with Pioneer IV.** *Nature*, London, 184(4682):219–224, July 25, **1959.** 4 figs., 2 tables, 17 refs. **DWB**—An interpretative discussion of the performance of the U. S. deep-space probe Pioneer IV is made. The report compares its observations with those of Pioneer III and with those made by the first Soviet cosmic rocket. It further analyzes the radiation intensity observed beyond 92,000 km from the center of the earth, the paucity of energetic plasma in interplanetary space during March 3–6, 1959, the lack of influence of the moon, the effective extent of the geomagnetic field, the terrestrial ring current of Dolginov and Pushkov, and gives a redetermination of the interplanetary cosmic-ray intensity in all directions. *Subject Headings:* **1. U. S. space probe 1959 (Pioneer IV) 2. Satellite cosmic ray data.**—*N.N.* Ⓢ

11.12–523 551.507.362.2:551.521.64

Second IGY space probe. *American Geophysical Union, Transactions*, 40(1):66–67, March **1959. DWB**—Preliminary results of the 38 hour flight of Pioneer III provided valuable data. There are two radiation belts: the first between 1400 and 3400 miles from the earth, the second between 8000 and 12000 miles. Each of these has a very high intensity of charged particles. The counts are equal to about 10 roentgens/hr, if electrons, or about 100 if protons. *Subject Headings:* **1. U. S. Space probe Pioneer III 2. Van Allen belts.**—*E.Z.S.* Ⓢ

11.12–524 551.507.362.1:523.3

U. S. Moon Rocket Pioneer IV. *Current Science*, Bangalore, 28(3):100, March **1959. DWB, DLC**—The U. S. four-stage Juno II rocket was launched on March 3, 1959 from the Cape Canaveral missile test center (Florida). It carried a 13.4 lb gold plated space probe,

Pioneer IV. At 22.24 hrs GMT on March 4, the space probe by-passed the moon at a distance of 37,771 miles from it. This is more than 17,000 miles further away than was planned. Data were received on the telemeter by Jodrell Bank and the Goldstone tracking stations until March 6. By then it had gone 406,020 miles from the earth and was travelling at 3899 mph. *Subject Headings:* **1. Moon rockets 2. U. S. space probe Pioneer IV 3. Cape Canaveral.** —*N.N.* Ⓢ

11.12–525 551.507.362.1

Sovetskaia kosmicheskaia raketa. [The Soviet space rocket.] *Priroda*, Moscow, No. 2:17–30, Feb. **1959.** 9 figs. **DLC**—The contents of this paper comprise the following, viz: a detailed account of the path of the cosmic rocket which was shot into space by the Soviet Union Jan. 2, 1959; a description of the last stage of the cosmic rocket and of the container with the scientific apparatus, the instrumentation for following the course of the rocket and for receiving its signals; the studies that can be made with the rocket on cosmic radiation, the gaseous components of interplanetary matter, the corpuscular radiation of the sun, meteoritic particles and magnetic properties of the earth and moon. Also the artificial sodium comet and the apparatus for making it are described. Diagrams showing the approach of the rocket to the moon, path of the rocket on a star map and computed orbit of an artificial planet relative to the sun, and a map giving the successive positions of the rocket projected on the surface of the earth are presented. Illustrations of the container with apparatus in place are reproduced. *Subject Heading:* **1. Soviet space probe 1959 (Lunik I).**—*I.L.D.* Ⓢ

11.12–526 551.507.362.1:521.62

Iakhontova, N. S., **Kosmicheskaia raketa—pervaia iskusstvennaia malaia planeta.** [Cosmic rocket —the first artificial small planet.] *Priroda*, Moscow, No. 4:5–8, April **1959.** 2 figs., 2 tables. **DLC**—The cosmic rocket launched on Jan. 2, 1959 which entered into its heliocentric orbit on Jan. 7–8, passed the perihelion on Jan. 14 whereby its distance from the Sun was 0.979 astronomic unit, while the distance between the Earth and the Sun at that time amounted to 0.984 a.u. Due to an insignificant eccentricity in its aphelia the rocket will move beyond the limits of the earth's orbit, but will remain in the confines of the Martian orbit. Possibilities and methods of predicting and calculating the position of the rocket in 5–10 years are discussed. *Subject Heading:* **1. Artificial planets.**—*A.M.P.* Ⓢ

11.12–527 551.507.362.2:521.5

Raimond, J. J., Jr., **Kunstplanetoide I.** [Artificial planetoid I.] *Hemel en Dampkring*, 57(3):60–72, March **1959.** 8 figs. **DWB, DLC**—The author describes and calculates hypothetically the path followed by the artificial Russian planet Lunik to arrive in its orbit. He uses the data of the Harvard Announcement Card 1421: half major axis: 1.15 A. U.; orbital time: 1.23 year; eccentricity: 0.148; perihelion distance: 0.98 A.U., about 14-1-1959; aphelion distance: 1.32 A.U. about September 1959; inclination with respect to the ecliptic plane about 0°; perihelion length probably about 117°. Supposing that the artificial planet left the Earth with a velocity of 11.0 km/sec, he calculates that it escaped the Earth-Moon system with a velocity of about 3 km/sec with respect to the Moon and entered into the heliocentric coordination system with an estimated velocity of 33 km/sec with respect to the Sun. *Subject Heading:* **1. Artificial planets.**—*A.V.* Ⓢ

11.12–528 778.3:523.34:551.507.362.1

Tret'ia sovetskaia kosmicheskaia raketa. [Third Soviet cosmic rocket.] *Priroda*, Moscow, No. 11:3–15, Nov. **1959.** 7 figs. **DLC**—A detailed account of the third cosmic rocket released by the USSR on October 4, 1959 is presented. With the aid of diagrams and photographs the author discusses the construction, instrumentation, energy supply, orientation, etc. of this cosmic rocket which is designed especially to photograph the Moon, the trajectory and orbit of the lunar satellite, the photographing and transmission of the images and the principal features of the dark side of the Moon as revealed by the photographs of the satellite. *Subject Headings:* **1. Soviet rockets 2. Moon rockets 3. Lunar photographs.**—*I.L.D.* Ⓢ

11.12–529 551.507.362.1:523.3

The third Russian space rocket. *Nature*, London, 184(4690):852, Sept. 19, 1959. **DWB**—A short note on the multi-stage space rocket launched in the U.S.S.R. on Oct. 4, 1959. The details of launching, of the separation of an instrumented vehicle from the rocket, and of the vehicle's orbits around the Moon and the Earth are reported. The instrumented vehicle carried apparatus to photograph the unseen part of the moon. It was equipped with radio transmitters run by chemical and by solar batteries. *Subject Headings:* **1. Soviet rockets 2. Moon rockets.**—*I.S.* Ⓢ

11.12–530 551.507.362.1:523.3

Lunik III: the Russian third moon rocket. *Current Science*, Bangalore, 28(10):393, Oct. 1959. **DWB, DLC**—A brief note on the third Russian cosmic rocket launched on Oct. 4, 1959. The multi-stage rocket put into orbit an "automatic interplanetary station" which, after circling the moon, returned toward the earth and is now orbiting the earth. The significance of this feat for interplanetary exploration is emphasized and its launching and operation details are given. *Subject Headings:* **1. Soviet space probe 1959 Theta (Lunik III) 2. Moon rockets.**—*I.S.* Ⓢ

7. SATELLITES

A. Aerodynamics, Drag

11.12–531 551.507.362.2:533.6

Schaaf, S. A. (*Univ. of Calif.*), **Aerodynamics of satellites.** *Rand Corporation, Santa Monica, [Publication]* R-339, **1959.** Paper No. 1 [13 p.]. 7 refs., eqs. **DWB** (M10.5 R186ae)—Various phases of aerodynamics applicable to artificial satellites are summarized. Solutions for questions connected with the important contribution of aerodynamic forces to the gradual decay of artificial satellites in their orbits are investigated. The decay rate measurements in the so-called free molecule flow regime are analyzed along the classical free molecule flow theory. The chief difficulty in free molecule aerodynamics is the prediction of the normal and tangential components of momentum of remitted molecules. The analysis of the so-called Maxwell reflection coefficient showed the necessity for additional parameters for the exchange of energy and normal momentum. Some experiments aimed to provide more adequate models are indicated. A model is proposed to visualize the interaction between "clean" surfaces and incident oxygen atoms and nitrogen molecules moving at quite high velocities, based on the supposition that atmospheric oxygen is dissociated into atoms while nitrogen is still in molecular state at typical satellite perigee altitudes. The forces due to oxygen and to nitrogen are analyzed separately and are then combined. The satellite altitude vs. flow is discussed in the cases of convex and non-convex geometries, the satellite drag problem remaining still unsolved. *Subject Headings:* **1. Satellite orbits 2. Aerodynamic forces on satellites 3. Satellite drag.**—*O.T.* Ⓢ

11.12–532 551 507.362.2:533.6

DeBra, D. B. (*Lockheed Aircraft Corp., Palo Alto, Calif.*), **Effect of aerodynamic forces on satellite attitude.** *Journal of the Astronautical Sciences*, N. Y., 6(3):40–45, Autumn **1959.** 9 figs., 10 refs., 11 eqs. **DWB**—The effects of torques due to aerodynamic drag and the gravity gradient are computed for satellites orbiting at altitudes of between 80 and 375 miles. Motion about the pitch axis is discussed and the equilibrium position is determined as a function of altitude for both a dumbbell and cylindrical-shaped object. The equilibrium position of the cylindrical object in three dimensions is considered as a function of altitude. Equations are presented in the appendix. *Subject Headings:* **1. Satellite drag 2. Satellite attitude.**—*Author's abstract.* Ⓢ

11.12–533 551.507.362.2:538.69:537.56

Beard, David B. (*Lockheed Missiles and Space Div., Palo Alto and Univ. of Calif., Davis*). **Induction drag on satellites.** *Rand Corporation, Santa Monica, (Publication)*, R-339, **1959,**

Paper No. 17 (10 p.). foot-ref., 16 eqs. **DWB** (M10.5 R186ae)—The charge interaction of positive ions and negative electrons with the satellite surface is analyzed under various conditions on the basis of some pertinent velocities and distances, as cyclotron period and radius for electrons, cyclotron radius for ions, Debye shielding distance, and collision frequency for electrons. The electric field component perpendicular to the magnetic field is of interest due to plasma conductivity essentially governed by the magnetic field. The satellite motion and induced voltage perpendicular is illustrated and examined under various conditions in order to determine the integral of the current. On examining the resulting satellite drag a torque is indicated which would cause tumbling unless the neutralized particle was reflected isotropically from a sphere and the power loss is proportional to the curve of the satellite dimension while the drag is proportional to the square of it. If the neutral density is less than the ion density and the satellite is larger than 50 m the inductive drag will exceed the ordinary neutral or ion drag. The usefulness of electrical power generation is indicated by the result that a satellite of 100 m diameter could generate about a hundred watts of electrical power if its skin were composed of conducting strips separated by insulating layers. *Subject Headings:* **1. Satellite drag 2. Satellite power supply.**—*O.T.* Ⓢ

11.12–534 551.507.362.2:551.510.535

†Wyatt, P. J. (*Ford Motor Co., Calif.*), **Induction drag on a large negatively charged satellite moving in a magnetic-field-free ionosphere.** *Journal of Geophysical Research*, Wash., D. C., 65(6):1673–1678, June **1960.** 6 refs., 23 refs. **Comment** by David B. Beard and Francis S. Johnson, *Ibid.*, 65(10):3491–3492, Oct. **1960.** Also **Comment** by A. L. Licht, *Ibid.*, p. 3493. **DLC**—An induction drag, experienced by a charged satellite during its traversal of the ionosphere, has been theoretically postulated by several authors. Previous 'exact' treatments of the problem are inapplicable to large systems, and the semiempirical approach of Jastrow and Pearse may yield somewhat questionable results. The present description initially considers the satellite as a completely permeable spherical shell of charge, thus avoiding the difficult boundary conditions introduced by the 'exact' linearized treatment. The effects of permeability are then shown to be approximately removable by means of an iterative process. A final result, apparently valid to within an order of magnitude, is obtained for the drag force arising solely from electrical effects. Its magnitude is considerably less than that obtained by Jastrow and Pearse. *Subject Heading:* **1. Satellite drag.**—*Author's abstract.* Ⓢ

11.12–535 551.507.362.2:551.510.535:551.594.13

Rand, S. (*Convair, San Diego, Calif.*), **Wake of a satellite traversing the ionosphere.** *Physics of Fluids*, N. Y., 3(2):265–273, March/April **1960.** 6 figs., 2 refs., 65 eqs. **DWB**—The particle treatment is applied to a study of the structure of the wake behind a charged body moving supersonically through a low-density plasma. For the case of a body whose dimensions are considerably smaller than a Debye length, a solution is obtained which is very similar in structure to the solution obtained by using the linearized fluid dynamics equation. For the case of a disk whose radial dimensions are much larger than a Debye length, two conical regions are found in the wake. At the surface of each of these cones, over thicknesses of the order of a Debye length, the ion and electron densities are increased over their ambient values. Formulae for the electrohydrodynamic drag on a wire, and on a large disk are obtained. *Subject Headings:* **1. Satellite drag 2. Ionization by satellites.**—*Author's abstract.* Ⓢ

11.12–536 551.507.362.2:551.510.535:551.594.13

Rand, S. (*Convair, San Diego, Calif.*), **Damping of the satellite wake in the ionosphere.** *Physics of Fluids*, N. Y., 3(4):588–599, July/August **1960.** 3 figs., table, 10 refs., 79 eqs. **DWB**—Landau damping of the ion plasma oscillations which constitute the wake of a line charge moving supersonically through a low-density plasma is studied. Maxwellian distribution functions in the ambient plasma for both electrons and ions have been assumed. It is found that the damping is critical to the question of whether the electrohydrodynamic wake produced by a satellite in the ionosphere is observable, unless the electron temperature is at least an order of magnitude greater than the ion temperature. *Subject Headings:* **1. Satellite drag 2. Ionization by satellites.**—*Author's abstract.* Ⓢ

B. Orbits, Perturbations, Acceleration, Deceleration, Lifetime

See also: **First and second derivatives in elliptic motion** (Schütte), 11.12-477; **Rendezvous of astrovehicles** (Swanson, Petersen), 11.12–514.

11.12–537 551.507.362.2:521.312

Small, Ballard B. (*Atlantic Missile Range, Patrick Air Force Base, Fla.*), **The earth satellite orbit.** *Astronautics*, N. Y., 4(1):40–41, 46–48, Jan. **1959.** figs., port, vita. **DLC**—The orbital elements for earth satellites are called equatorial elements. The elements are given in a list. Satellite velocities are not elementary parameters. By knowing the orientating elements, the theoretical space position of the satellite can be calculated. Even without the disturbing forces, orbital elements are true constants only for arbitrary instants chosen for mathematical convenience. *Subject Heading:* **1. Satellite orbits.**—*A.H.K.* Ⓢ

11.12–538 551.507.362.2:521.312

Cormier, Leonard N.; Goodwin, Norton and Squires, Reginald K., **Simplified satellite prediction from modified orbital elements.** *IGY World Data Center A* (*Rockets and Satellites*), *National Academy of Sciences, Wash., D. C., IGY Satellite Report Series*, No. 7, Jan. 1, **1959.** 54 p. charts, 6 tables. **DWB**—The problem of supplying prediction data for IGY satellite observers is discussed in terms of the need for providing a large number of stations with "fresh" data in a useful form. A straightforward method is given whereby an observer can: (a) eliminate all but potentially significant observation periods; (b) for any such period, determine the precise time when the satellite will cross (or approach) his latitude circle, the longitude of the crossing (or approach), and the satellite height; and (c) derive from such crossing (or approach) data the azimuth, elevation and slant range to the satellite for one or more optical observations, or comparable data for radio observations. The method is specifically designed to direct primary consideration to the times when the orbit plane (without regard to the satellite position) passes through a selected point on the observer's meridian. Modification of the orbital elements permits direct application of the observer's geographical coordinates for first determining the times of approach of the orbit plane, and for then determining the relative position of the satellite. Prepared message forms, computation forms, tables and charts that may be used for graphic solutions are given. *Subject Headings:* **1. Satellite tracking 2. Satellite orbits.**—*Authors' abstract.* Ⓢ

11.12–539 551.507.362.2:551.510.3:521.312

Whitney, Charles A. (*Smithsonian Astrophysical Obs. and Harvard College Obs., Cambridge, Mass.*), **Orbital dynamics and the interpretation of orbital data.** *Rand Corporation, Santa Monica*, [*Publication*] R-339, **1959.** Paper No. 2 [24 p.]. fig., 2 tables, 17 refs., numerous eqs. **DWB** (M10.5 R186ae)—The geopotential field and orbit perturbations are analyzed on the basis that if the earth is described as a solid of revolution, its potential may be expressed by an expansion in terms of spherical harmonics. The complicated set of perturbations thus derived is divided into short period, long-period and secular perturbations, and in considering the Newtonian orbit valid, into a constant perturbation. Summarizing the results of this analysis: the satellite determination of the coefficient of the first harmonic is still preliminary; that of the third harmonic is derived from Vanguard I only and the values of the second and fourth coefficients are derived by examination of selected data only. Examining orbit perturbations produced by atmospheric drag (disregarding the major uncertainty in the derivation of densities in the value of drag coefficient) the implications of atmospheric structure, the secular perturbations introduced by drag, the periodic perturbations introduced by drag, and the modification of the secular changes introduced by the solid body rotation of the atmosphere are investigated. The present status of each case and the tasks for further research are presented. Tables show long period perturbations of Vanguard I and exact value of element derivatives. Quantities proportional to the integrands in the secular equations for a typical satellite orbit are plotted into the diagram. *Subject Headings:* **1. Satellite orbit dynamics 2. Satellite drag.**—*O.T.* Ⓢ

11.12–540 551.507.362.2:521.312

FitzGibbon, Mary C. (*G. E. Co., Missile and Space Vehicle Dept., Philadelphia*), **Satellite orbit control system.** *American Astronautical Society, New York, Advances in the Astronautical Sciences*, Vol. 5, **1959,** issued **1960.** p. 82–97. 12 figs., table, numerous eqs. **DWB** (629.1388 A512pro), **DLC** (QB1.A26)—The results of a satellite orbit control study program which was initiated to determine a simple and accurate way to circularize an elliptical orbit or to effect a desired coplanar orbit transfer are presented. A method of determining orbit parameters through the use of an infrared horizon sensor system and the equations which relate orbit altitude and the sensor system outputs are discussed. The various positions on an orbit where correction may be applied and some of the possible types of correction are mentioned. A brief discussion evaluates the merit of each method of circularization. A correction computer is described. *Subject Heading:* **1. Satellite orbit control.**—*Author's abstract.* Ⓢ

11.12–541 551.507.362.2:551.312.4

Merson, R. H.; King-Hele, D. G. and Plimmer, R. N. A. (*all, Royal Aircraft Estab., Farnborough, Hants*), **Changes in the inclination of satellite orbits to the equator.** *Nature*, London, 183(4656):239–240, Jan. 24, **1959.** fig., 2 refs., 2 eqs. **DLC**—A more thorough investigation of the details of changes in the orbital inclination of Sputnik 2 (1957 B) has been made, taking into account the spread of atmospheric resistance around perigee. It is agreed that the rotation of the atmosphere is responsible for the major part of the observed effect. Details are discussed and equations derived. *Subject Headings:* **1. Satellite orbits 2. Soviet satellite 1957 Beta (Sputnik II).**—*N.N.* Ⓢ

11.12–542 551.507.362.2:521.312

Kislik, M. D., **Dvizhenie iskusstvennogo sputnika v normal'nom gravitatsionnom pole Zemli.** [Movement of an artificial satellite within the earth's normal gravitational field.] *Iskusstvennye Sputniki Zemli*, Moscow, No. 4:3–17, **1960.** 6 refs., 52 eqs. **DLC**—The problem of the motion of an artificial satellite in the normal gravity field of the Earth is considered without accounting for the effects of air resistance and gravity anomalies. The results obtained may be applied in calculating orbits of high-flying satellites and also for quantitative analysis of the influence of the oblateness of the Earth upon the motion of satellites. *Subject Heading:* **1. Satellite orbits.**—*Transl. of author's introduction (G.T.)* Ⓢ

11.12–543 551.507.362.2:521.312:551.510.3:526.7

King-Hele, D. G. (*Royal Aircraft Establishment, Farnborough*), **Analysis of the orbits of the Russian satellites.** *Royal Society of London, Proceedings, Ser. A*, 253(1275):529–538, Dec. 29, **1959.** 8 figs., 12 refs., 5 eqs. **DWB, DLC**—This paper describes some recent results obtained from an analysis at the Royal Aircraft Establishment of the orbits of Sputniks 2 and 3. Three main topics are discussed: (1) irregularities in air density in the upper atmosphere; (2) the changes in the inclination of the orbit to the equator, and what can be learned from them; (3) the earth's gravitational field. In the first two of these subjects the results are rather speculative and are intended to point the way towards future possibilities rather than to provide numerical answers. *Subject Headings:* **1. Satellite orbits 2. Soviet satellite 1957 Beta (Sputnik II) 3. Soviet satellite 1958 Delta (Sputnik III) 4. Upper atmosphere densities.**—*Author's abstract.* Ⓢ

11.12–544 551.507.362.2:521.312:521.12

Musen, Peter (*Nat. Aero. & Space Admin., Wash., D. C.*), **On the motion of a satellite in an asymmetrical gravitational field.** *Journal of Geophysical Research*, Wash., D. C., 65(9):2783–2792, Sept. **1960.** 2 refs., 67 eqs. **DLC**—Existing satellite data have a tracking precision and a limited interval of observation sufficient only for the determination of the zonal harmonics in the geoid. With the availability of more accurate data, extended over longer intervals of time, it will also become possible to determine the tesseral harmonics in the gravitational field. The present theory, developed in anticipation of the availability of these data, extends the work published by the author recently to permit the easy inclusion of the influence of tesseral harmonics and consequently also of gravitational anomalies, in the motion of an artificial satellite. *Subject Headings:* **1. Satellite gravity observations.**—*Author's abstract.* Ⓢ

11.12–545 551.507.362.2:521.312

Grebenikov, E. A. (*Shternberg State Astron. Inst. U.S.S.R.*), **Secular perturbations in the theory of motion of an artificial earth satellite.** *Soviet Astronomy AJ*, New York, 3(6):1023–1032, May/June **1960.** 13 refs., 31 eqs. Transl. of **O vekovykh vozmushcheniiakh v teorii dvizheniia iskusstvennykh sputnikov Zemli.** *Astronomicheskiĭ Zhurnal*, Moscow, 36(6):1111–1121, Nov./Dec. **1959. DLC**—The problem on the analytical determination of secular perturbations in the theory of motion of artificial earth satellites is considered in the first approximation, taking into account the flattening of the Earth, and air resistance. The model of the atmosphere, proposed by D. E. Okhotsimskiĭ, T. M. Eneev, and G. P. Taratynova was used for deriving the secular perturbations due to air resistance. The secular perturbations of the elements of the orbit of the American satellite 1958β_2 were found from the obtained formulas. *Subject Headings:* **1. Satellite orbits 2. Satellite drag.**—*Author's abstract.* Ⓢ

11.12–546 551.590.21/2:551.507.362.2:521.312

Upton, E.; Bailie, A and Musen, P. (*all, Natl. Aeronautics & Space Admin., Wash., D. C.*), **Lunar and solar perturbations on satellite orbits.** *Science*, Wash., D. C., 130(3390):1710–1711, Dec. 18, **1959.** 2 figs., eqs. **DLC**—Calculations of the solar and lunar effects on highly eccentric satellite orbits show that the sun and the moon may cause large changes in perigee height over extended periods of time. The amplitude and sign of the perigee height variations depend on the orbit parameters and the hour of launch; for a typical orbit and various choices of launch time, the perigee height will either rise or fall at the rate of 1 km/day over the course of several months. These results may be significant in deciding the launch conditions for future satellites with highly eccentric orbits. *Subject Headings:* **1. Solar effects on satellite orbits 2. Lunar effects on satellite orbits.**—*Authors' abstract.* Ⓢ

11.12–547 551.507.362.2:521.312.44:551.510.3

Batrakov, Iu. V. and Proskurin, V. F., **O vozmushcheniiakh orbit iskusstvennykh sputnikov, vyzyvaemykh soprotivleniem vozdukha.** [Perturbations of artificial satellite orbits caused by the resistance of the air.] *Iskusstvennye Sputniki Zemli*, Moscow, No. 3:39–46, **1959.** 4 refs., 23 eqs. **DLC, DWB.** Summary in *U. S. National Aeronautics and Space Administration, Technical Translations*, F-8:3–4, April **1960.** English transl. in *Ibid.*, No. F–46, Nov. 1960. 13 p. 4 refs., etc. **DWB**—A general form of first order perturbations in the elements of the elliptical orbit of a satellite caused only by atmospheric resistance is sought. It is assumed that the earth's atmosphere has a strictly spherical density distribution and that the earth's attraction can be substituted by the attraction of a material point located at its center of inertia and having the same mass as the earth. Perturbations which do not exceed the period of one revolution of the satellite, are obtained, together with secular preturbations. The short period perturbations caused by the resistance of the atmospheric medium have not yet been studied, according to the authors. A numerical example, showing the comparative value of first order perturbations caused by the resistance of the air is given. *Subject Headings:* **1. Satellite orbits 2. Air density effects on satellites.**—*E.K.* Ⓢ

11.12–548 551.507.362.2:521.312

Groves, G. V. (*University College, London*), **Motion of a satellite in the earth's gravitational field.** *Royal Society of London, Proceedings, Ser. A*, 254(1276):48–65, Jan. 19, **1960.** fig., 8 refs., 180 eqs. **DWB, DLC** (Q41.L7)—The equations of motion of a satellite are given in a general form, account being taken of the precession and nutation of the Earth. The main part of the paper deals with the motion arising from the gravitational field of the Earth, expressed as a general expansion in spherical harmonics. By evaluating the partial derivatives in Lagrange's planetary equations, expressions are obtained for the rates of change of the orbital elements. Particular consideration is given to the form of the expressions for the secular terms arising from the first four zonal harmonics. *Subject Heading:* **1. Satellite orbits.**—*Author's abstract.* Ⓢ

11.12–549 551.507.362.2:521.312

Jacchia, L. G. (*Astrophysical Observ., Smithsonian Inst.*), **The diurnal effect in the orbital acceleration of satellite 1957 Beta one.** *Smithsonian Institution, Astrophysical Observatory*,

Special Report No. 20:5–8, Jan. 5, **1959.** fig., table, 2 refs. **DWB.** Reprinted in *IGY, 1957/1958. IGY World Data Center A, Rockets and Satellites, IGY Satellite Report Series*, No. 8:71–74, June 15, **1959.**—The observations of the Vanguard Satellite 1958 Beta made it clear that the fluctuations in the observed accelerations are of atmospheric origin. The results for 1957 Beta are re-appraised in this light. Table I gives the geometric angular distance between the perigee and the Sun. The observed accelerations are plotted in Fig. 1. The magnitude d of the diurnal effect is expressed as $d = .0017\ A(\psi - \psi_0)$ where A is the undisturbed acceleration and $\psi - \psi_0$ is expressed in degrees. *Subject Headings:* **1. Satellite acceleration 2. Soviet satellite 1957 Beta (Sputnik II).**—*E.K.* Ⓢ

11.12–550 551.521.67:551.510.3:551.507.362.2:521.312.2

Jacchia, L. G., **Solar effects on the acceleration of artificial satellites.** *Smithsonian Institution. Astrophysical Observatory, Special Report* No. 29, Sept. 21, **1959.** 15 p. 4 figs., 2 tables, 8 refs. **DWB**—Four types of fluctuations are described and explained. Those following the rhythm of the solar flux at 2800 Mc probably reflect variations in atmospheric density caused by variable short-wave solar radiation. A slow fluctuation connected with the position of the perigee with respect to the sub-polar, reflects a difference in the density profiles of the bright and dark hemispheres of the earth. Transient fluctuations accompanying magnetic storms should reflect a heating of the atmosphere through some interaction with corpuscular radiation. Erratic fluctuations of unexplained origin indicate a connection with conditions in the radiation belts. The diagrams illustrate the correspondence of the different accelerations by each solar disturbance. The secular acceleration for three satellites as well as relative positions of sun and perigee for them are shown in tables. *Subject Headings:* **1. Corpuscular radiation 2. Solar corpuscular influences on upper atmosphere 3. Short wave radiation effects on density gradients 4. Satellite acceleration.**—*O.T.* Ⓢ

11.12–551 551.507.362.2:521.312

Paetzold, H. K. (*Max-Planck Inst. of Aeronomy*), **The fluctuations of the acceleration of satellites.** *Journal of Atmospheric and Terrestrial Physics*, N. Y., 16(3/4):259–262, Nov. **1959.** fig., table, 16 refs., 2 eqs. **DWB, DLC** –The main part of the fluctuations of the acceleration appears to be caused by the atmosphere itself. The satellite irregularities are noted, that of Sputnik III graphically represented, and the mean amplitude of the fluctuations for four satellites is tabulated. The possible causes of fluctuations are examined. *Subject Headings:* **1. Satellite acceleration 2. Soviet satellite 1958 Delta (Sputnik III).**—*I.S.* Ⓢ

11.12–552 551.507.362.2:521.312

Bacon, Ralph Hoyt (*General Precision Lab., Pleasantville, N. Y.*), **On the retardation of a satellite.** *American Journal of Physics*, N. Y., 27(2):69–72, Feb. **1959.** 16 eqs. **DWB**—As the satellite is slowed down by the tenuous upper atmosphere, its period is shortened; the greater the energy losses, the greater the shortening of the period. This surprising result is due to the fact that at the vertices of the elliptic path, the loss of potential energy alone is greater than the loss of total energy caused by any single retarding impulse; a retarding impulse at any point of the satellite's path, therefore, produces at some other point of the path a gain of kinetic energy greater than the loss of total energy at the point at which the impulse was received. *Subject Headings:* **1. Satellite retardation 2. Satellite energy loss.**—*Author's abstract.* Ⓢ

11.12–553 551.507.362.2:550.388

Wilson, Raymond H., Jr. (*Goddard Space Flight Cent., NASA, Wash., D. C.*), **Geomagnetic rotational retardation of satellite 1959α 1 (Vanguard II).** *Science*, Wash., D. C., 131 (3395): 223–225, Jan. 22, **1960.** fig., 9 eqs., 9 refs. **DLC**—Radio observations made during the battery life of Vanguard II showed that the satellite's rotation was being retarded exponentially at a rapid rate. Precise analysis of electromagnetic couples on the conducting and magnetic parts of the satellite indicates a mean ambient geomagnetic field of 0.158 gauss, and confirms the eddy-current theory previously applied to Vanguard I. *Subject Headings:* **1. U. S. satellite 1959α (Vanguard II) 2. Geomagnetic effects on satellite rotation.**—*Author's abstract.* Ⓢ

11.12–554 523.74:551.507.362.2

Priester, Wolfgang, **Sonnenaktivität und Abbremsung der Erdsatelliten.** [Solar activity and deceleration of earth satellites.] *Die Naturwissenschaften*, Berlin, 46(6):197–198, March **1959.** 1 fig., 6 refs. **DLC**—The object of the author is to stress the remarkable correlation between the irregular fluctuation in the rotation time of satellite 1957 Beta (Sputnik 2) and the variation in radio radiation in the 20 cm band during Dec. 1957 and Jan. 1958. The article mentions a statement of JACCHIA, BRIGGS and NONWEILER. *Subject Headings:* **1. Solar activity 2. Satellite deceleration 3. Solar effects on satellites.**—*A. V.* Ⓢ

11.12–555 551.507.362.2:521.312.7:525.35

Casci, Corrado and Giavotto, Vittorio, **Sul tempo di vita dei satelliti artificiali.** [The lifetime of artificial satellites.] *International Astronautical Congress, Amsterdam, Aug. 1958, Proceedings of the 9th Congress*, Vol. 1:343–358, issued **1959.** 8 figs., 11 refs., 54 eqs. plus 10 eqs. English, German and French summaries. **DLC** (TL787.I44)—The authors treat the problem of computing the lifetime of an artificial satellite of the Earth, considering the effect of the Earth's rotation. The problem is studied from an energy point of view: exchanges are considered between satellite potential energy due to the Earth's gravitational field, satellite kinetic energy, and drag. Exchanges between the two former energies are conservative but those involving the latter are always irreversible; they are expressed by the work dissipated in the atmosphere by drag. Drag is expressed by the classical formula of aerodynamics; in this formula the drag coefficient is taken from the latest studies on rarefied gases, and air density is expressed by an exponential formula in accordance with the "Rocket Panel" of 1952. At first simple formulas are derived which are concerned with satellites in circular equatorial orbits; in this case computations prove that the effect of the Earth's rotation is a variation of lifetime of about +14% if atmospheric velocity and satellite velocity have the same direction, or −14% if they have opposite directions. The problem is then generalized to include the case of a satellite in elliptic non-equatorial orbits. Using the formulas here derived computations are made with a high-speed digital computer; the results of these computations are plotted in a diagram. This diagram permits a direct evaluation of lifetimes, but has the uncertainty inherent in the constants of the exponential formula of atmospheric density; however it is possible to correct these constants using the formulas here derived, and taking as data the lifetimes of satellites already fallen. *Subject Heading:* **1. Satellite lifetime computation.**—*Authors' abstract.* Ⓢ

c. Observation, Tracking

11.12–556 551.507.362.:521.312

Bullis, E. P. and Campbell, Leon, Jr. (*both, Astrophysical Observ., Smithsonian Inst.*), **Moonwatch catalogue–September, 1958.** *Smithsonian Institution. Astrophysical Observatory, Research in Space Science, Special Report* No. 20:19–46, Jan. 5, **1959.** tables. **DWB**—The operations of different moonwatch stations in connection with American and Russian satellites are described. Separate chronological listings are given for each satellite. Only observations from registered moonwatch stations are included. Following the catalogue of moonwatch observations are two complete lists of moonwatch station coordinates. The first list is by registered station number and the second is alphabetical by country. The columns in these lists of station coordinates are station no., east longitude, latitude, altitude in meters and station name. *Subject Headings:* **1. Satellite tracking 2. Moonwatch observational data.**—*A.H.K.* Ⓢ

11.12–557 551.507.362.2(47)

Ogorodnikov, K. F. (*Interplanetary Committee of the Sovietic Academy of Science*), **Preliminary summary of optical observations of artificial earth satellites.** *International Astronautical Congress, Amsterdam, Aug. 1958, Proceedings of the 9th Congress*, Vol. 1:434–444, issued **1959.** 4 figs. English, German and French summaries. **DLC** (TL787.I44)—A chart shows the locations of 66 visual and 24 photographic satellite tracking stations distributed throughout the Soviet Union including the Arctic. More than 3000 students, teachers and

scientific workers participate in the visual program beginning Oct. 1957 and in the photographic program from Jan. 1958. Details of program, equipment (2000 simple telescopes were manufactured for use), reports by telegraph, organization details and problems, training school (at Ashkabad) where 130 teacher astronomers were trained for positions of chiefs or assistant chiefs of stations, are given. Results of operation of stations, accuracy of observations, accuracy of time signals, future plans for use of light signals from satellites and photometric observations are outlined. *Subject Headings:* **1. Satellite tracking network of U.S.S.R. 2. Optical satellite observations 3. U.S.S.R.**—*M.R.* Ⓢ

11.12–558 551.507.362.2(480)

*Järnefelt, G., **On visual observations of artificial earth satellites in Finland.** Discourse delivered at Chalmer's University of Technology, Gothenberg, April 22, **1959.** 23 p. tables, foot-refs.—Describes the observation of earth's satellites in Finland. Three of these bodies observable by naked eye in Finland were Sputnik I rocket, Sputnik II and Sputnik III rocket. Each of these bodies was as large as a railway carriage. The meteorological observatory at Jokionen had three balloon theodolites at its disposal to observe Sputnik III. The Finnish Meteorological office kept in constant touch with the American and the Soviet authorities. Most of the Finnish work concentrated on the location of positions, due to lack of funds. *Subject Headings:* **1. Visual satellite observations 2. Finland.**—*A.H.K.* Ⓢ

11.12–559 551.507.362.2:522.2

Escher, Peter H. and Michelson, Gunnar P., **All sky surveillance system for satellite detection.** *Electro-Optical Systems, Inc., Pasadena, Calif., EOS Report* 290-Final, July 25, **1960.** 94 p. appendixes. figs., tables, eqs. **DWB**—This report summarizes the results of an analysis, design study, and model specification conducted for the Geophysical Research Directorate of the Cambridge Research Center. The feasibility of an electro-optical Sky Surveillance System affording hemispherical coverage for the acquisition and tracking of unannounced satellites is established. A design employing a detector mosaic in configuration with a scanning telescope is advanced. In its first version, the design will be capable of acquiring and subsequently tracking unknown satellites displaying a brightness equalling a third order of magnitude star or better. For relatively small additional cost the same design can be enabled to detect objects of the fifth or sixth stellar magnitude by a simple numerical increase of detector cells within the detector mosaic and a corresponding increase of preamplifiers and decision making discriminator circuits. The outputs of the discriminator circuits are sampled by an electronic commutator. Output pulses announcing the presence of a target and identifying which of the individual cells within the detector mosaic has made the acquisition are telemetered to the ground together with telescope position information. This data, which may be presented on a conventional PPI scope, will furnish vector information of a satellite, hence will make the establishment of its orbital trajectory possible. *Subject Heading:* **1. Satellite tracking.**—*Authors' abstract.* Ⓢ

11.12–560 551.508:771.3:551.507.362.:521.312

Abele, M. K. (*Astronomical Obs., Latvian State Univ.*), **Long-focus cameras for determining coordinates of faint artificial earth satellites.** *Soviet Astronomy AJ*, New York, 4(1):134–139, July/Aug. **1960.** 6 figs., 7 refs., 8 eqs. **DLC.** Transl. of **O primenenii dlinnofokusnykh kamer dlia opredeleniia koordinat slabykh iskusstvennykh sputnikov Zemli.** *Astronomicheskiĭ Zhurnal*, Moscow, 37(1):140–145, Jan./Feb. **1960. DLC**—The use of long-focus cameras of low aperture for photographic tracking of earth satellites is discussed. Two ways of increasing the limiting stellar magnitude, using special plate holders with a moving plate, are described. A cam, dimensioned to specifications, is rotated by a synchronous motor to move the plate in the first method. Instants of time are recorded on a chronograph. The second method utilizes sinusoidal oscillations of the plate, excited by a special electromagnet. Moments of time are recorded by an electronic oscillograph. Photographs obtained by both techniques are reproduced, and an evaluation of the precision of the techniques is made. *Subject Headings:* **1. Photographic equipment 2. Satellite tracking 3. Astrophotography.**—*Author's abstract.* Ⓢ

11.12–561 551.507.362.2:778.3

Iakovlev, N. V., **K voprosu o primenenii zerkal'no-linzovykh ob"ektivov dlia fotografirovaniia iskusstvennykh sputnikov Zemli (ISZ).** [Application of mirror-lens objectives for the photography of artificial earth satellites.] *Astronomicheskiĭ Zhurnal*, Moscow, 37(3):550–554, May/June **1960.** table, 8 refs., 3 eqs. Russian and English summaries p. 550. Transl. into English in *Soviet Astronomy AJ*, New York, 4(3), **1960. DLC**—Data on the dimensions and main optical characteristics of a high-speed mirror-lens objective are given. The objective permits the photography of artificial earth satellites of the sixth magnitude on a film with sensitivity of about $500\frac{1}{\text{lux}\times\text{sec}}$. *Subject Headings:* **1. to Photographic satellite tracking 2. Photographic equipment.**—*Author's abstract.* Ⓢ

11.12–562 551.506.7:778.3:551.507.362.2

Jaschek, W. J. (*Kuffner-Sternwarte, Austria*), **Die photographische beobachtung künstlicher Satellitoide.** [Photographic observation of artificial satellitoides.] *International Astronautical Congress, Amsterdam, Aug. 1958, Proceedings of the 9th Congress*, Vol. 1:88–91, **1959.** fig., eq. English, German and French summaries. **DLC** (TL787.I44)—The artificial satellites of the present time have angular velocities of about 1°/sec. The photographic observation of such objects in order to determine their positions is superior to the visual method. Prerequisites for photographing are, of course, sufficient brightness of the satellite and a suitable photographic equipment. The chief problem of both methods is precise timing. Considering these circumstances and assuming an accuracy of timing within $\pm 0.01 \div \pm 0.2$s, lenses with focal lengths of 5 cm will prove to be sufficient, i.e., the commercial 35 mm cameras may be used. The tolerances of the various parameters obtained from observation are estimated; it is imperatively essential that the data of the place of observation should be known with fairly high precision. *Subject Heading:* **1. Photographic satellite tracking.**—*Author's abstract.* Ⓢ

11.12–563 551.508:551.521.18:551.507.362.2

Borchert, Carl F., **The design of infrared equipment for satellite detection.** Massachusetts Institute of Technology. Naval Supersonic Lab., Contract AF 19(604)-4547, Scientific Report No. 1, Sept. **1959.** 62 p. 17 figs. (incl. photo), 2 tables, 3 refs., numerous eqs.—The problem of observing satellite vehicles with an infrared detector is discussed with emphasis on the design of an optimum ground based detection system. Near infrared radiation due to the passage of a satellite is assumed. Theoretical considerations for obtaining the maximum signal-to-noise ratio from the detecting element are presented with a preliminary comparison of several methods of attack. Consideration is also given to optical systems with large collector diameters and large fields of view. Some preliminary experiments are described. *Subject Headings:* **1. Satellite tracking 2. Infrared detectors.**—*Author's abstract.* Ⓢ

11.12–564 521.6:551.507.362.2

Baldesent, D., **L'astronome amateur face aux satellites artificiels.** [The amateur astronomer confronted by artificial satellites.] *L'Astronomie*, Paris, 73(3):125–128, March **1959.** 2 figs., 2 refs. **DLC**—Directions relating to observation of the artificial satellites, reporting the existence of a publication providing weekly ephemerides of artificial satellites visible to the naked eye. Author indicates a simple graphic representation permitting to determine easily, by means of their ephemerides, the data relating to the trajectories of the satellites: positions of the orbital plane, its inclination on the equator, altitude of passage, location of perigee, etc. *Subject Heading:* **1. Visual satellite observations.**—*A. V.* Ⓢ

11.12–565 551.507.362.2:621.396.8

Munro, G. H. and Heisler, L. H. (*both, Radio Res. Bd. Sydney Univ.*), **Recording radio signals from earth satellites.** *Nature*, London, 183(4664):809–810, March 21, **1959.** fig., ref. **DWB**—A simple and very satisfactory Doppler frequency shift system developed at the radio laboratory at the University of Sydney is described and discussed. The total Doppler shift

of 20,005 Mc/s is 1000 cycles. One of the many good features of the recording system is the accuracy by which the slope of the Doppler shift curve $\partial F/\partial t$ is derived at the point of closest approach. Dependency of rate of change of $\partial F/\partial t$ on h (height) and V (velocity) of the satellite enables V/h curves to be derived (by a Siliac computer) for the overhead case and one other transit, intersection of which establishes the satellite's velocity and height. Facsimile record of signals from Sputnik III is given and the analysis of recordings since the end of Aug. is now in process. *Subject Headings:* **1. Radio satellite tracking 2. Soviet satellite 1958 Delta (Sputnik III).**—*W.N.* Ⓢ

11.12–566 551.507.362.2621.396.8

Munro, G. H. (*Radio Research Board Lab., Univ. of Sydney*), **Diurnal lapse of signals from Sputnik III.** *Nature*, 183(4674):1549, May 30, **1959.** ref. **DLC.** [**Comment by**] B. G. Pressey. *Ibid.*, 184(4682), Suppl. No. 5:261, July 25, **1959. DLC**—Munro reports observations made at Blaxland, near Sidney, Australia of radio signals from Satellite 1958δ2. These were started shortly after the satellite started orbiting in May 1958. No definite failure of signal was observed until early March 1959; since that time, however, there have been definite lapses of modulation. These lapses occur when the satellite is not illuminated by the sun. Even in the absence of pulse modulation, a weak background signal can be detected on close transits. Pressey reports observations made at Slough, England and at Singapore, which confirm the absence of pulse signals during darkness, but show no evidence of the background signal observed in Australia. *Subject Headings:* **1. Radio satellite tracking 2. Soviet satellite 1958 Delta (Sputnik III).**—*G.T.* Ⓢ

11.12–567 551.507.362.2:621.396.8:535.33

Armier, G., **L'écoute des satellites artificiels au centre R.T.F. de Limours.** [Monitoring of artificial satellites at the R.T.F. station at Limours.] *L'Onde Electrique*, Paris, 39(388/389): 654–659, July/Aug. **1959.** 5 figs., 2 tables. **DLC**—The article is divided into two parts: a) The monitorings: durations, sub-division, statistics, influence of orbital position, abnormal propagation; b) Measurement of frequencies. Emphasis is placed on the special details of the equipment used for 20 Mc/s. The method is completely automatic, the only adjustment is that of setting the receiver on frequency. A counter automatically records the frequency shift. The accuracy of one cycle is obtained for signals of less than 1 microvolt at the input of the receiver. The maximum speed of operation is about one complete measurement of frequency every 2 seconds. The study is concluded by the analysis of some curves showing frequency shift due to Doppler effect. *Subject Headings:* **1. Radio satellite tracking 2. Limours, France.**—*Author's abstract.* Ⓢ

11.12–568 551.507.362.2:521.312

Slack, F. F. and Sandberg, A. A., **Tracking and display of earth satellites.** *Institute of Radio Engineers, N. Y., Proceedings*, 48(4):655–663, April **1960.** 11 figs. (incl. photo), ref., 22 eqs. **DLC**—In a new method of displaying the predicted paths and real-time positions of artificial earth satellites, cathode-ray tubes are used with two types of map overlays: orthographic projection and Mercator projection. Functions to match these projections are generated electronically. Auxiliary satellite information is cataloged and made available through "light gun" interrogation of the satellites displayed on the CRT. The display and orbit simulator can be used as an integral part of a live tracking system. A mathematical derivation of the subsatellite path on the orthographic projection is given. *Subject Heading:* **1. Satellite tracking.**—*Authors' abstract.* Ⓢ

11.12–569 551.507.362.2

Swerling, Peter, **First order error propagation in a stagewise smoothing procedure for satellite observations.** *Journal of the Astronautical Sciences*, N. Y., 6(3):46–52, Autumn **1959.** 72 eqs. **DWB**—A practical method of smoothing satellite data by evaluating a finite number of parameters, or elements, is presented. *Subject Heading:* **1. Satellite observation.**—*Author's abstract.* Ⓢ

D. Scientific and Other Uses

See also: **Antiparticles in space** (Hones), 11.12–1; **Radio astronomical measurements** (Lovell), 11.12–39; **Measurement of cosmic noise above ionosphere** (Tyas et al.), 11.12–44; **Micrometeorite measurements from 1958 satellites** (Manring), 11.12–154; **Meteoritic microphone detectors** (Oklahoma State U.), 11.12–155; **Exploring depth of surface layer of the Moon from radar space observatory** (Fensler et al.), 11.12–180; **Vanguard measurements of Earth's figure** (O'Keefe et al.), 11.12–189; **Earth's oblateness in terms of satellite orbital periods** (Blitzer), 11.12–190; **New value of Earth's flattening** (King-Hele, Merson), 11.12–191; **Experiments on cosmic radiation** (Powell), 11.12–205; **Ionizing radiation** (Rosen et al.), 11.12–206; **Cosmic radiation intensity decreases observed** (Fan et al.), 11.12–213; **Energetic particle fluxes** (Gold), 11.12–230; **Van Allen radiation belts** (Section B3), 11.12 267 to 11.12–292; **Current system in vestigial geomagnetic field** (Sonett et al.), 11.12–297; **Extraterrestrial current system** (Smith et al.), 11.12–317; **Survey of geomagnetic field in space** (Vestine), 11.12–318; **Electron density and ionic mass spectrum** (Sayers), 11.12–350; **Satellite measurements of ionosphere** (Section B6d), 11.12–364 to 11.12–379.

11.12–570 551.507.362.2

Stephens, W. H. (*Ballistic Missiles, Ministry of Supply*), **Earth satellites.** *Royal Aeronautical Society, Journal*, 63(583):394–414, July **1959.** 26 figs., 10 refs., eqs. **DWB**—The paper discusses the general characteristics of near earth satellites and the scientific exploration made possible by their use as observing platforms. The later sections of the paper have a bearing on the possibilities and engineering problems of space probes and space travel. The author's purpose is to make clear the basic factors. The accent is on the scientific value of satellites, and some of the general design considerations. The general discussion which followed the reading of the paper is also reproduced. *Subject Headings:* **1. Satellite observatories 2. Astronautics.**—*I.S.* Ⓢ

11.12–571 551.507.362.2:523.87:523.40

Hoyle, F. (*Univ. of Cambridge*), **Astronomical observations with the aid of artificial satellites.** *Royal Society of London, Proceedings, Ser. A*, 253(1275):492–493, Dec. 29, 1959. ref. **DWB, DLC**—The author assumes that the advantages offered in astronomical research by artificial satellites would include: a) the observation of distant galaxies and masses of interstellar gas, b) promotion of stellar spectroscopy by penetrating into the ultraviolet, c) photography of stellar nebulae at shorter waves, and d) gamma-ray astronomy. The invention of new and more effective scientific instruments is considered as a very important feature of satellite development. *Subject Heading:* **1. Satellite uses in astronomy.**—*E.K.* Ⓢ

11.12–572 551.507.362:523

Roman, Nancy G. (*Astron. and Astroph. Programs, NASA*), **Satellite astronomical observatories.** *Aero/Space Engineering*, 19(5):86–87, May **1960.** Port. and vita p. 87. **DLC**—Projects of stabilized satellites by NASA for the next five years which will enable unobstructed views of celestial objects are surveyed. The probability of the preference of the natural moon against artificial satellites for advanced astronomical observations is emphasized because the moon provides shielding against terrestrial interference. *Subject Headings:* **1. Astrophysical observations from satellites 2. Satellite uses in astronomy.**—*O.T.* Ⓢ

11.12–573 551.507.362.2:521.312:522.2

Goldberg, Leo (*Univ. of Michigan Obs.*), **Astronomy from satellites and space vehicles.** *Journal of Geophysical Research*, Wash., D. C., 64(11):1765–1778, Nov. **1959.** 9 figs., 6 refs. **DLC**—A comprehensive survey of problems related with space experiments in the field of astronomy. The prospect is to put an astronomical telescope into orbit. The sun will have very high priority as an object for investigation from space vehicles. Interesting experiments are being planned for the observation of X-rays and ultraviolet radiation from the sun. Another series of experiments would be concerned with recording images of the entire sun in monochromatic radiation at ultraviolet and X-ray wavelengths. The understanding of the sun serves also to expand our knowledge of the other stars. Galactic and extragalactic research

will probably proceed in two stages: (1) the ultraviolet radiation from the night sky has to be mapped first and after that (2) the galactic investigation might be carried out with accurately controlled telescopes in satellites. *Subject Headings:* **1. Satellite uses in astronomy 2. Telescopes on satellites.**—*E.K.* Ⓢ

11.12–574 551.507.362.2:522.2:521.312

Davis, Robert J. (*Astrophysical Observ., Smithsonian Inst.*), **Progress report on the planning of an artificial satellite containing an astronomical telescope.** *Smithsonian Institution. Astrophysical Observatory, Special Report,* No. 20:9–12, Jan. 5, **1959.** 2 figs., 3 refs. **DWB**—The efforts of the Smithsonian Astrophysical Observatory to launch an artificial satellite are described. The equipment of the satellite is being designed to give maximum information in keeping with the available engineering techniques. Television techniques show that it is possible to map the entire celestial sphere. Further studies have shown that a spherical configuration is more suitable than a cylindrical one. The stabilization of the system will be controlled by Earth sensors and Sun sensors. *Subject Headings:* **1. Satellite uses in astronomy 2. Telescopes.**—*A.H.K.* Ⓢ

11.12–575 551.507.362.2:521.312:522.2:523.40

Whipple, Fred L. (*Smithsonian Astrophysical Obs.*), **Notes on the immediate feasibility of an orbiting astronomical telescope.** *International Astronautical Congress, Amsterdam, Aug. 1958, Proceedings of the 9th Congress,* Vol. 1:92–95, issued **1959.** English, German and French summaries. **DLC** (TL787.I44)—Preliminary feasibility studies have been made of the scientific and technological aspects of placing an astronomical telescope in a satellite orbit. These studies have shown that within a relatively short time schedule such a telescope is indeed possible if the launching facilities are made available. No major technological developments are required, and the telescope can be constructed, launched, and operated by reasonably simple modifications of instrumentation that have already been tested and techniques that are now in use. The telescope will be able to survey the entire sky, with a comparatively high resolving power, in a selected spectral region below 1300 Å in the far ultraviolet. It is evident from the wealth of new material to be obtained in the far ultraviolet regions of the spectrum that progress in astrophysics and our understanding of the universe can be vitally accelerated by an orbiting telescope. *Subject Headings:* **1. Satellite uses in astronomy 2. Telescopes.**—*Author's abstract.* Ⓢ

11.12–576 551.507.362.2:526.7

Systems Laboratories Corporation, Sherman Oaks, Calif., **Geodetic use of artificial earth satellites.** Contract AF 19(604)-5517, Final Report, Aug. 15, **1959.** 2 vol. (119 and 87 p.), figs. (many fold.), 54 refs. (appended at end of each vol.). **DWB**—This report discusses various ways in which an artificial earth satellite may be used to provide the geodesist with more accurate information about the relation between different geodetic data. The various available methods are discussed both from a general point of view and in terms of a number of specific methods which have been proposed for this purpose. These include both optical and electronic techniques and in each case the predicted accuracy of the principal datum ties is discussed. Connection methods based both on orbit prediction and on simultaneous visibility of the satellite from the data are investigated. The report is divided into two parts; Part I presents a general, non-mathemetical discussion of the problems and methods and summarizes our principal conclusions; Part II presents a more detailed technical analysis of the accuracy of various methods, of equipment design and performance and of the effects of physical phenomena, such as ionospheric and atmospheric fluctuations, on the measurements. *Subject Heading:* **1. Satellite uses in geodesy.**—*Author's abstract.* Ⓢ

11.12–577 551.507.362.2:521.312:526.7

Lautman, Don A. (*Smithsonian Astrophysical Obs., Cambridge, Mass.*), **Computations.** *American Geophysical Union, Geophysical Monograph,* No. 4:83–86, **1959.** eq. **DWB, DLC** (QB275.C64)—Remarks on two phases of computations: what geodetic data can be derived from satellite orbits? How do we go about computing these data? Also considers what can-

not be computed from satellite orbits—gravity anomalies and the geocentric constant GM. We have the extreme difficulty of developing a perturbation theory which increases many-fold as one strives to increase the accuracy by going to higher and higher orders, and the practical impossibility of handling some kinds of perturbation and air drag. In a panel discussion MYRON LECAR explained some of the problems in Project Vanguard. LUIGI G. JACCHIA discussed irregularity of atmospheric fluctuations. *Subject Headings:* **1. Satellite orbits 2. Perturbation theories 3. Geodetic measurements from satellites 4. Project Vanguard.** —*E.Z.S.* Ⓢ

11.12–578 551.507.362.2:521.6:526.7

O'Keefe, John A. (*Goddard Space Flight Center, NASA*), **Determination of the earth's gravitational field.** *Science*, Wash., D. C., 131(3400):607–608, Feb. 26, **1960.** 4 refs. **DLC**—Also in: International Space Science Symposium, Nice, Jan. 1960, **Space Research: proceedings of the First Symposium.** Pub. **1960.** p. 448–457. 6 figs., 17 refs. Russian summary p. 448. **DWB** (523.1 I61sp)—BRENNER et al. have pointed out that spurious variations may be introduced into computation of satellite orbits by a combination of the use of osculating elements and a maldistribution of the observations. They suggest that this circumstance is the source of the eccentricity variations in the Vanguard I orbit which have been attributed to the third zonal harmonic. This criticism is based on a misunderstanding of the Vanguard orbit and tracking programs. The source materials for our study of the third zonal harmonic were not osculating elements, and the observations were in fact uniformly distributed around the Vanguard I orbit. *Subject Headings:* **1. Satellite orbits 2. U. S. Satellite 1958 Beta (Vanguard I).**—*Author's abstract.* Ⓢ

11.12–579 551.594.12:550.38:551.507.362.2

Van Allen, James A.; McIlwain, Carl E. and Ludwig, George H. (*all, Dept. Physics, Univ. Ia. Ia. City, Ia.*), **Satellite observations of electrons artificially injected into the geomagnetic field.** *Journal of Geophysical Research*, Wash., D. C., 64(8):877–891, Aug. **1959.** 20 figs., 3 tables, 5 refs. **DLC**—Four radiation detectors in satellite 1958ε (Explorer IV) easily and promptly observed the geomagnetically trapped electrons resulting from the three high-altitude nuclear detonations Argus I, II, and III in August-September 1958. An account of over 160 satellite passes through the three Argus "shells" of artificially injected electrons is given herein, and a preliminary appraisal of the geophysical significance of these experiments is offered. *Subject Headings:* **1. Satellite observations 2. Van Allen belts 3. U. S. Satellite 1958 Epsilon (Explorer IV) 4. Argus experiment.**—*Authors' abstract.* Ⓢ

11.12–580 551.507.362.2:551.521.64/67

International Geophysical Year, 1957/1958. IGY World Data Center A [for] Rockets and Satellites, Wash., D. C., **Observations of corpuscular radiation with satellites and space probes.** Its *IGY Satellite Report*, No. 11, June **1960.** 125 p. figs., photos, refs., tables. Collection of articles from *Nature*, London, *Journal of Geophysical Research* and *Planetary and Space Science*, and three unpublished articles (all abstracted separately). **DWB** (629.1388 I612sa)—A collection of fourteen separate papers consisting of reports of observations of corpuscular radiation with satellites and space probes. There are several articles dealing with different aspects of the Van Allen radiation belts. Various experiments on cosmic radiation, i.e. ionizing radiation, soft radiation etc. are also reported. This report is issued in accordance with international arrangements concerning the responsibilities of IGY Data Centers. *Subject Headings:* **1. Satellite corpuscular radiation observation techniques 2. Van Allen belts 3. Corpuscular radiation.**—*I.S.* Ⓢ

11.12–581 551.507.362.2:551.510.536:551.594.12

Pletnev, V. D., **Proniknovenie bystrykh zariazhennykh chastits iz verkhneĭ atmosfery v ionosferu.** [Penetration of fast moving charged particles from the upper atmosphere into the ionosphere.] *Akademiia Nauk SSSR, Izvestiia, Ser. Geofiz.*, No. 8:1164–1166, Aug. **1959.** 9 refs., 7 eqs. Russian summary, p. 1164. **DWB, DLC**—Observation in the upper atmosphere of charged particles with energies from low (kev) to high (Mev) by means of the artificial satellites are reviewed from the point of view of their oscillatory movements in the earth's

magnetic field. Mathematical analysis of the movements of charged particles at different altitudes (500 to 3000 Km) under different angles to the magnetic power lines (0 to 90°) indicates sharply defined space anisotropy due to the absorbing action of lower atmospheric layers. *Subject Headings:* **1. Satellite radiation measurements 2. Upper atmosphere radiation.**—*N.P.S.* Ⓢ

11.12–582 551.508:551.507.362.2

Boyd, R. L. F. (*Dept. of Physics, Univ. College, London*), **Some techniques of physical measurement.** *Royal Society of London, Proceedings, Ser. A*, 253(1275):516–522, Dec. 29, **1959.** fig. **DWB, DLC**—There are a few techniques of physical measurements which have not gained as much favor in satellite instrumentation as might have been expected. These are 1) microwave spectroscopy and 2) the Langmuir probe. The first part of the paper discusses the importance of the information-carrying capacity of photographic film, the second part is a comprehensive description of the work in progress at University College along the lines of the Langmuir probe. *Subject Headings:* **1. Satellite instrumentation 2. Langmuir probe technique 3. Microwave spectroscopy.**—*E.K.* Ⓢ

11.12–583 551.507.362.2:621.396.8:551.510.535

Douglas, J. N.; Huguenin, G. R. and Lilley, A. E., **A very low frequency radio experiment for satellite and probe transportation.** Yale University. Observatory, Contract AF 19(604)-3059, Final Report, Jan. **1960.** 36 p. numerous figs. (incl. photos), numerous tables, 3 refs. numerous eqs.—The objectives of Contract AF 19(604)-3059 are: theoretical and experimental investigations of the ionospheric regions above the maximum of the F2 layer, by utilizing observations of extraterrestrial low-frequency radio noise made in rocket probes and satellites. The following sources of VLF radiation are examined: general cosmic environment, synchrotron radiation, plasma and shock waves, Cerenkov radiation, parametric oscillations, free-free transitions, solar disturbances, non-thermal planetary radiation, and terrestrial disturbances. Based upon predicted VLF intensities to be expected from cosmic sources of radiation, performance specifications on the antennae and radiometers are developed. Three complete satellite payloads have been constructed for rocket probe and satellite transportation. Each payload operates at 13.25, 7.0, 2.2, and 0.7 Mc. Ground-based radiometers and ground-based transmitters have been constructed for terrestrial correlation studies and "closed-loop" tests of ionospheric leakage. *Subject Headings:* **1. Satellite ionospheric observations 2. VLF radio wave propagation 3. Radio noise propagation in ionosphere.**—*Authors' abstract.* Ⓢ

11.12–584 551.507.362.2:662.2:539.1

Satellite Systems proposed to detect atom blasts in space. *Science*, Wash., D. C., 130(3369):208–209, July 24, **1959. DLC**—A news item reporting a recent proposal, recommended by the representatives of the three nuclear powers at Geneva, that one of the three satellite systems be used to detect atomic blasts in space. Under the proposal, satellites weighing several thousand pounds would be put into orbit to monitor and report on atomic blasts in outer space. *Subject Headings:* **1. Satellite uses 2. Atomic explosion detection.** —*I.S.* Ⓢ

11.12–585 551.501.81 551.508.85

Keigler, J. E. and Krawitz, L. (*both, R. C. A., Princeton, N. J.*), **Weather radar observations from an earth satellite.** *Journal of Geophysical Research*, Wash., D. C., 65(9):2793–2808, Sept. **1960.** 9 figs., 2 tables, 3 refs. **DLC**—The major physical problems encountered in the design of a weather radar satellite stem from the volume of the atmosphere to be sampled and the radar characteristics of clouds, precipitation, and the surface of the earth. Solutions to these problems are sought in the application and extension of conventional radar techniques, electronic scanning, correlation techniques, and precipitation-ground discrimination methods. Consideration is given to the special environment of a satellite radar and to the ground processing of the data to be obtained. The characteristics of a minimal orbital radar system that could be produced today are discussed. *Subject Headings:* **1. Weather radar applications 2. Satellite radar techniques.**—*Authors' abstract.* Ⓢ

11.12–586 551.507.362.2:526.1:778.35

Glaser, Arnold H. and Milford, S. N. (*both, Allied Research Associates, Inc.*), **Preliminary investigation of the nature of the infrared view of the earth's atmosphere from a satellite.** *U. S. Air Force. Cambridge Research Center, GRD Research Notes*, No. 36:115–152, June **1960.** 23 figs., table, 9 eqs. **DWB**—An extensively illustrated discussion about the use of a scanning device that would create pictures as seen by infrared light. The present discussion is limited to water-vapor emission. The atmosphere is viewed at such a wavelength where the water vapor is quite opaque. The view of the atmosphere as seen in an intense emission (and absorption) band of water is reported to be that of a glowing fog. A simplified approach yielding approximate numerical results is presented to demonstrate the behavior of the radiation. A heuristic approach is then adopted to investigate the meteorological significance of the radiation. Finally, a discussion of some applications is presented. *Subject Headings:* **1. Satellite observation techniques 2. Infrared photography.**—*I.S.* Ⓢ

11.12–587 551.507.362.2:551.508.761:778.38

Boucher, R. J. (*Allied Research Associates, Inc.*), **Photogrammetric method of obtaining the camera axis and its application in determining the time of photographs taken from a space vehicle.** *U. S. Air Force, Cambridge Research Center, GRD Research Notes*, No. 36:93–99, June **1960.** 3 figs., eq. **DWB**—The lack of sufficient data does not permit the application of mapping techniques to cloud photographs obtained from meteorological satellites. The procedure reported here was developed to remove this difficulty. It was designed specifically to provide data necessary for the interpretation of pictures taken from the Atlas Missile 11C. But this technique, or a slightly modified version, may be applied to pictures received from any missile or satellite vehicle for the purpose of providing or verifying data on the azimuths of the principal lines, or camera axes, and the time of the pictures. *Subject Headings:* **1. Satellite cloud photography 2. Cloud cameras.**—*I.S.* Ⓢ

11.12–588 551.507.362.2:531.76

Badessa, R. S.; Kent, R. L. and Nowell, J. C. (*Research Lab. of Electronics, M. I. T., Cambridge, Mass.*), **Short-time measurement of time dilation in an Earth satellite.** *Physical Review Letters*, N. Y., 3(2):79–80, July 15, **1959.** 1 fig., 6 eqs., 5 refs. **DLC**—A method for measuring the gravitational red shift, causing clocks at different gravitational potentials to run at different rates, is described. The basic principle is that the satellite will transmit a "precorrected" signal cancelling the first order Doppler shift. *Subject Headings:* **1. Satellite time dilation 2. Chronometry.**—*W.N.* Ⓢ

11.12–589 551.507.362.2:530.12

Ginzburg, V. L., **Artificial satellites and the theory of relativity.** *Scientific American*, N. Y., 200(5):149–160, May **1959.** 6 figs., 2 tables. **DWB, DLC**—A discussion of the general theory of relativity which was published in 1916 by ALBERT EINSTEIN and the new method for verifying it by artificial earth satellites. These satellites are also being experimented with in the hope that they may help scientists to obtain precise measurements of the gravitational frequency shift. *Subject Headings:* **1. Satellite verification of relativity theory 2. General theory of relativity 3. Gravity.**—*N.N.* Ⓢ

11.12–590 551.507.362.2:621.396.8:527

Moody, Alton B., **Navigation using signals from high-altitude satellites.** *Institute of Radio Engineers, N. Y., Proceedings*, 48(4):500–506, April **1960.** 3 figs. (incl. photo). **DLC**—If electronics can be satisfactorily applied to celestial navigation, a system having universal coverage without weather limitations might be produced. Radio stars are not a promising possibility, but the sun and moon are being tracked by the U. S. Navy Radio Sextant, AN/SRN-4, to provide limited coverage. Universal coverage might be achieved by the addition of artificial earth satellites. Satellites in orbits a few hundred miles from the earth might be used in some form of piloting system, but orbit prediction problems, limited coverage by individual satellites, and computer complexities are serious obstacles to be overcome by such a system. A different approach would be to place three or four satellites in orbits at an optimum

distance somewhere between 1000 and 12,000 miles from earth to serve as artificial celestial bodies in a system that would be a natural evolution from traditional celestial navigation methods. A stabilized directional antenna operating with a receiver capable of accepting signals from both the satellites and the sun would provide angle measurement data both for fixing the position of the craft and also for establishing a north reference. The degree of sophistication of the user equipment would differ with requirements. *Subject Heading:* **1. Satellite uses in navigation.**—*Author's abstract.* Ⓢ

11.12–591 551.507.362.2:521.312:527

Guier, W. H. and Weiffenbach, G. C., **A satellite doppler navigation system.** *Institute of Radio Engineers, N. Y., Proceedings*, 48(4):507–516, April **1960.** 2 figs., 3 tables, 11 refs., 11 eqs. **DLC**—It is shown that a satellite Doppler navigation system can provide navigation to at least one-half mile accuracy from a single pass of a satellite, provided that proper use is made of the full Doppler curve. While not extensively discussed, a satellite Doppler navigation system is presented which conveniently provides navigators with all necessary inputs for position calculation, including up-to-date orbital data. The main body of the paper presents the results of a comprehensive error analysis which proves the feasibility of achieving navigational accuracies of one-half mile using such a system under realistic conditions. *Subject Heading:* **1. Satellite uses in navigation.**—*Authors' abstract.* Ⓢ

e. Specific Satellites

See also: **Re-entry of Sputnik I rocket** (Harris, Jastrow), 11.12–496; **Geomagnetic rotational retardation of Vanguard II** (Wilson), 11.12–553; **Lapse of signals from Sputnik III** (Munro), 11.12–566.

11.12–592 551.507.362.2

"Most scientific" satellite put in orbit Aug. 7. *Science*, Wash., D. C., 130(3373):442, Aug. 21, **1959.** photo. **DLC**—This announces the launching of a 142-lb satellite designed to conduct 15 experiments during its life span. The launching vehicle, a 3-stage Thor-Able rocket, left its pad at Cape Canaveral at 10:23 a.m. on Aug. 7. The satellite has an apogee of 26,400 miles and a perigee of 156. Its devices are enumerated. Among them is a micrometeorite detector to gage the size and speed of meteoric particles hitting the satellite, two types of magnetometers to map the Earth's magnetic field and four experimental arrangements designed to study the behavior of radio waves. *Subject Headings:* **1. U. S. Satellite 1959 Delta (Explorer VI) 2. Satellite instrumentation.**—*N.N.* Ⓢ

11.12–593 551.506.22:551.507.362.2

IGY satellite 1959 Eta. *American Geophysical Union, Transactions*, 40(4):384–388, Dec. **1959.** fig. **DWB, DLC**—The last of the Vanguard satellites (Vanguard III), launched from Cape Canaveral, Florida, Sept. 18, 1959, represents a contribution to the IGY and its extension, IGC-59. Aboard 1959 Eta are instruments to measure the earth's magnetic field, X-radiation from the sun, and several aspects of the space environment. The article gives information about the launching, characteristics, instrumentation, tracking and orbital data of the satellite. *Subject Headings:* **1. U. S. Satellite 1959 Eta (Vanguard III) 2. IGY satellite program.**—*E.K.* Ⓢ

11.12–594 551.507.362.2:551.521.64:550.388

Ludwig, George H. and Whelpley, William A. (*both, State Univ. of Iowa*), **Corpuscular radiation experiment of satellite 1959 Iota (Explorer VII).** *Journal of Geophysical Research*, Wash., D. C., 65(4):1119–1124, April **1960.** 6 figs., 5 tables. **DLC**—Satellite 1959 Iota (Explorer VII) carries an apparatus prepared by the Department of Physics and Astronomy of the State University of Iowa for comprehensive spatial and temporal monitoring of total cosmic-ray intensity, geomagnetically trapped corpuscular radiation, and solar protons. In view of the successful operation of the equipment during the first 2 months of flight and the expectation of its continued operation until October 1960, we have considered it desirable

and worth while to invite international participation in the recording and interpretation of the radiation observations. A full description of the apparatus is given, including detector calibrations, telemetry code, samples of actual recordings, and other pertinent information. *Subject Headings:* **1. Satellite cosmic ray recorders 2. U. S. Satellite 1959 Iota (Explorer VII) 3. Satellite radiation measurement technique.**—*Authors' abstract.* Ⓢ

11.12–595 551.507.362.2

Neue amerikanische Erdsatelliten. [New American earth satellites.] *Naturwissenschaftliche Rundschau*, Stuttgart, 12(12):467, Dec. **1959. DWB, DLC**—The U. S. Vanguard earth satellite released Sept. 18, 1959 carried instruments to measure the earth's magnetic field and the radioactivity of solar radiation. On Oct. 13 a many stage rocket of the type Juno II with a 41.175 kg satellite was shot off. This Explorer III is to provide data on weather processes in the earth's atmosphere. *Subject Heading:* **1. U. S. satellites.**—*I.L.D.* Ⓢ

11.12–596 551.507.362.2:531.36

Perkel, Harold (*RCA Astro-Electronic Products Div., Princeton, N. J.*), **Tiros I spin stabilization.** *Astronautics*, N. Y., 5(6):38–39, 106, June **1960.** figs., photos. **DLC**—Some of the approaches and solutions to the orientation and spin control problems in the development of Tiros I are explained: Yo-Yo, rockets and team combine to reduce initial spin, maintain desired spin, and fix the critical spin axis. Copies of blueprints show the coordinate system and the Team Precession Damping Mechanism. Photographs of the mounting of the ground actuated spin rockets, the position of the silicon solar cells, and the Yo-Yo de-spin mechanism as mounted in the satellite's base are included. *Subject Heading:* **1. Satellite control.**—*E.Z.S.* Ⓢ

11.12–597 551.507.362.2:521.6

United States satellite launched into orbit around Sun. *Science*, Wash., D. C., 131(3403): 815–816, March 18, **1960.** 2 photos. **DLC**—The launching of the United States 94.8 pound satellite, Pioneer V, in orbit around the Sun between Earth and Venus is briefly reported and the diagrams featuring the satellite shown. The new satellite, which was propelled at more than 24,869 miles an hour at third stage burnout, is designed to describe a 506 million mile path around the Sun at an average speed of about 70,000 miles an hour. *Subject Heading:* **1. U. S. Satellite 1960 Alpha (Pioneer V).**—*I.S.* Ⓢ

11.12–598 551.507.362.2

Freeman, John D. (*General Time Corp., N. Y.*), **The Tiros I timer.** *Astronautics*, N. Y., 5(6):35, 78–79, June **1960.** photo. **DLC**—This article reviews the functions and design of the new Tiros timer based on Incremag principles. Incremag—a registered trademark—is a transistorized magnetic counting circuit that delivers an output pulse after having received a predetermined number of input pulses. A photograph shows the complete Tiros I satellite timer and a schematic drawing illustrates the timing control system. *Subject Headings:* **1. Satellite timing 2. Chronometry.**—*E.Z.S.* Ⓢ

11.12–599 551.510.3:551.507.362.2:621.396

Warwick, J. W. (*High Altitude Observ., U. of Colorado, Boulder, Colorado*), **Decay of spin in Sputnik I.** *Planetary and Space Science*, N. Y., London, 1(1):43–49, Jan. **1959.** 4 figs., 5 refs., 41 eqs. **DLC**—A secular change took place in the spin-fading rate during the three weeks of observation of the radio transmissions from Sputnik I, between 4 October 1957 and 24 October 1957. This effect allows a determination of atmospheric density near the perigee point. For an assumed atmospheric scale height of 30 km, we derive a value 3.8×10^{-13} g cm^{-3} for the density at 220 km. Some fluctuations in the spin decay appear to be real, and may result from small changes in the orientation of the spin axis within the satellite. An alternative interpretation in terms of charged drag resulting from motion of the satellite through the ionospheric plasma, requires a charge of at least 10^4 volts on the satellite. This charge might be acquired in the auroral zone. *Subject Headings:* **1. Satellite spin decay 2. Satellite air density management techniques 3. Soviet satellite 1957 Alpha (Sputnik I).**—*Author's abstract.* Ⓢ

11.12–600 551.507.362.2

May, B. R. and Smith, D. E. (*both, Dept. of Scient. & Indust. Res., Ditton Pk., Slough, Bucks*), **The continued progress of satellite 1958δ_2 (Sputnik III).** *Nature*, London, 194(4689): 765–767, Sept. 12, **1959.** fig., table, 6 refs. **DWB**—A report of the work of Radio Research Station, Slough, which took over the responsibility since Oct. 31, 1958 of following the progress of the satellite and predicting its flight. The period-time curve plotted for prediction purposes, using radio and optical observations is discussed and graphically represented. The orbital elements for satellite for the period Nov. 1, 1958–May 1, 1959 are tabulated. *Subject Headings:* **1. Satellite orbits 2. Soviet satellite 1958 Delta (Sputnik III).**—*I.S.* ⑤

AUTHOR AND SUBJECT INDEXS

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